THIRD EDITION.

THE

AMATEUR'S MANUAL

OF

PHOTOGRAPHY.

EDITED BY

RICHARD KINGHAM.

CONTENTS:

LONDON: THOMAS KINGHAM, 3, Newman's Row, Lincoln's Inn, W.C.

May be had of all dealers in Photographic materials, and Opticians throughout Great Britain and Ireland, and the Colonies, and of all Booksellers and Newsvendors.

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¼	½	Stereo.	½	1	7¼ × 4½	
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14 0	14 0	19 0	20 0	36 0	24 0	per doz.
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	⅛	¼	½	⅓	6½ × 4¼	7¼ × 4½	½
	s. *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*
Common crown, per gross	0 10	1 6	2 6	...	...	...	...
Best polished and flatted crown, per gross	1 6	3 0	5 0	7 6	...	...	12 0
Ditto, per dozen	0 2	0 4	0 6	0 10	...	...	1 2
Extra thick crown, polished and flatted, per gross	...	...	8 0	13 0	17 6	24 0	20 0
Chance's patent plate, per dozen	0 4	1 0	2 0	3 0	...	5 0	4 6
Opal glass, best flat patent plate, per dozen	...	...	4 4	6 0	...	...	9 6

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	s.	*d.*		*s.*	*d.*
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,, ,, glacial ...	0	3	...	3	6
,, ,, ,, solid at 50°	0	6	...	5	0
,, citric	0	3	...	3	0
,, formic	0	3	...	3	6
,, nitric	0	2	...	1	3
,, pyrogallic, per dr. 8*d.*	4	6	...	60	0
Iron, proto-sulphate ...	0	1	...	0	6
,, ,, 7 lbs. 3*s.*					
Potassium, cyanide ...	0	3	...	3	0

	℔ oz.			℔ lb.	
	s.	*d.*		*s.*	*d.*
Potassium, iodide... ...	1	0	...	12	0
Soda, hypo-sulphite ...	0	1	...	0	5
,, ,, 7-lb. parcels, 2*s.* 6*d.*					
,, ,, 14 ,, ,, 4*s.* 6*d.*					
,, ,, 112 ,, ,, 28*s.*					
,, acetate	0	1	...	1	0
,, carbonate	0	1	...	1	0
,, nitrate	0	2	...	1	4
,, phosphate	0	1	...	1	0

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In all cases I guarantee the chloride of gold sold by me perfectly free from adulteration, and correct in weight. I ensure this by making the article on my own premises, and under my personal control.

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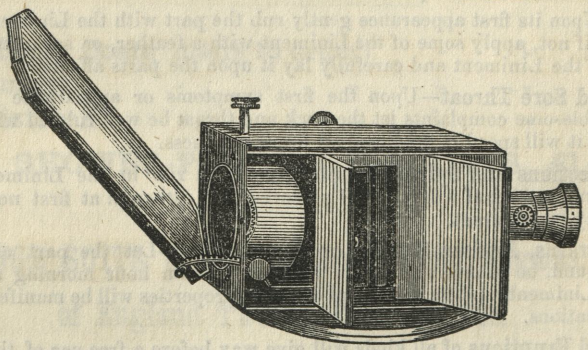

This useful instrument is now an established requisite in the Photographic Studio. J. A. manufactures it upon the most improved principles, which his long experience enables him to do; and, notwithstanding all the attempts made in France and Germany to introduce what they call an improvement, so far it is WOODWARD'S CAMERA IN PRINCIPLE, with an altered shape or size.

J. A. Challenges any artist who may have the so-called improved instrument, to produce better results than can be made with Woodward's.

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Pottery, Glass, Cabinet-Work, Passe-Partouts, Gold and other Frames, in every variety.

Large Dealers will be liberally dealt with. No Price List kept. Every Inquiry answered.

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PREFACE TO FIRST EDITION.

As a commercial pursuit, Photography is at the present moment the means of procuring the daily bread of tens of thousands of both sexes; and as a means of rational amusement as well as useful occupation it is practised by legions of amateurs. An art of so delightful and useful a character must necessarily receive an accession of thousands of votaries each succeeding year, and the special desire of the Editor of this pamphlet is to place before those about to commence the study of Photography, a treatise that will explain to them as tersely and clearly as possible all that it is necessary to do in the most important and most popular branches of the art. And at the same time it is his desire to introduce to advanced students novelties of a useful and interesting character. This, though apparently an extremely difficult task, the Editor trusts he has accomplished; for while imparting instructions to the uninitiated he has sought to avoid technicalities and at the same time to give those minutiæ so necessary to a beginner, which are almost invariably omitted from a treatise of this description; he has also introduced features into the work which cannot fail to prove valuable even to the experienced photographer. In proof of this last assertion, it is only necessary to call attention to the chapters on "Instantaneous" and "Landscape Photography" —"Enlarging," &c.

In conclusion the Editor presents his best thanks to all those who have so kindly assisted him with contributions, whether acknowledged or unacknowledged.

London, May 1864.

PREFACE TO SECOND EDITION.

In issuing a second edition of the "Amateur's Manual of Photography" the Editor has availed himself of the opportunity of correcting a few typographical errors that crept unobserved into a portion of first issue, and he has added several chapters on different branches of the Art of Photography to the work, which he trusts will render it more valuable as an instruction book and a book of reference.

It is a source of pleasure to him to know that his endeavours to place before photographic students a complete and practical treatise on the art of sun drawing have produced so much satisfaction, and he trusts that this and each succeeding annual edition will contain such improvements as to render it truly a good handbook of Photography for the current year.

London, March, 1865.

PREFACE TO THIRD EDITION.

The Editor, in presenting the "Amateur's Manual of Photography" for the third time to the students of that delightful art, would like to say a few words in reference to the book generally.

New matter has been added to this edition, which, in the Editor's opinion, embraces the most interesting modifications made public during the preceding year. Photography, although an art (or science?) in which progress is made annually, is of slow growth, and nearly all the "*improvements*" and "*new processes*" which are announced with so much pomp and excitement by their ingenious discoverers, when the first burst of surprise is over, and photographers have tested their merits, speedily drop into oblivion, and are forgotten; for as a rule these improvements are usually but a roundabout way of doing what can be done in a much more simple manner.

The Editor would impress upon the readers of the "Amateur's Manual of Photography" that the book before them is not the work of one person, but of several, each one contributing articles on those branches of the art of Photography in which he most excels; and it was only by adopting this course that the Editor thought it possible to place before students of Photography such a treatise as would enable them to acquire a thorough insight into this art-science, and also enable them to pursue their studies until proficiency, even in its highest branches, was obtained.

The Editor trusts that the readers of this new edition will find it a practical and trustworthy treatise on the art they are studying, and that it will afford the same satisfaction to them that its previous editions have to the thousands of students who have already made it their text book and guide.

London, March 31, 1866.

THE

AMATEUR'S MANUAL OF PHOTOGRAPHY.

Light.

THE first and perhaps the most important things to be considered by those studying the art of photography are the nature and various properties of light.

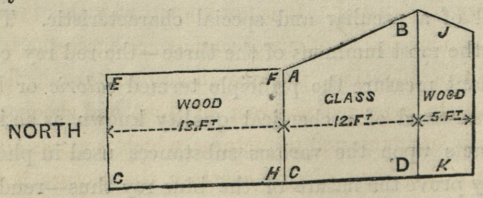
Before the time of Sir Isaac Newton, a ray of sunlight was supposed to be a *homogeneous* emanation, the exact character of which was a matter of mere speculation and surmise. It was that eminent philosopher who first made it known to the world, that light was a compound of seven rays of vivid colours united and blended together. The student may prove the nature and composition of a ray of ordinary white light by decomposing it by means of a prism, and receiving what is termed the prismatic image, or solar spectrum, on a white screen. He will perceive that this image is formed of three primary colours, viz., red, yellow, and blue—appearing in certain parts pure and in other parts mingled together. The compound colours of the solar spectrum so formed are four in number, viz., violet, indigo, green, and orange. The violet and indigo are compounds of the red and blue rays; green is a compound of the blue and yellow rays; and orange is a compound of the yellow and red rays.

Each of the primary constituent rays forming what is termed white light is possessed of a peculiar and special characteristic. The yellow ray is decidedly the most luminous of the three—the red ray contains in the most abundant measure the principle termed *caloric* or heat; and the blue ray is possessed of a chemical quality known as actinism, and is the ray that acts upon the various substances used in photography. The student may prove the nature of the blue ray thus—render a sheet

of paper sensitive to light by floating it first on a solution of chloride of sodium (common salt)—twenty grains to the ounce—and when dry by floating it again on a solution of nitrate of silver of the same strength, allowing it to remain on the latter bath a little longer than on the sodium bath. These operations must be performed in a room from which *white* light is excluded—yellow light must be used, and the paper must be dried under the same conditions. When dry, cover one portion of the paper with a piece of blue glass, another portion with a piece of yellow glass, and the third portion with a piece of red glass. Thus covered, expose it to the rays of the sun for ten minutes or so: on removing the pieces of glass, it will be found that the paper is very much discoloured where the light has acted through the blue glass, and that the parts covered by the yellow and red glass present scarcely any appreciable alteration. It is these various properties of light that render photography possible; without them it would be impossible. As it is out of the question to make all the preparations required by photography in absolute darkness, a non-chemical light must be used, and we have that in the yellow and red rays of the spectrum. The nature of the chemical action of the blue ray, or what is termed, *actinism*, is at the present moment but imperfectly understood, but in the opinion of many it is akin to that of electricity or magnetism.

The Glass House.

A GLASS HOUSE is almost an indispensable adjunct to portraiture. Of course portraits can be and are taken in the open air, but it is scarcely necessary to observe that this mode of proceeding involves many inconveniences and many disadvantages. The form of glass house recommended by the writer is indicated in the sketch below.



The part marked A, B, C, D, should be constructed of glass—on the top and on both sides. The northern and southern ends of the room may be constructed of wood or some opaque material. The sitter is placed at the southern end of the room marked J and K, where of course are the backgrounds, &c., and the photographer's post is at the northern end marked E, F, G, H, immediately adjacent to which should be the *dark room and work room*. The writer recommends two side lights as an advantage, as the sitter may be lighted from either, it frequently happening that a portrait taken from the right side of the face will be more pleasing than one taken from the left side and *vice versâ*. Of course but one light must be used at a time, and each side light must be furnished with a set of white and black calico curtains moving on rods, to be used to totally or partially exclude the light, according to the requirements of the artist. A white blind should also be attached to the top light, as that sometimes requires to be softened in order to get the best effect. The blinds should be moved by means of a rod with a suitable hook at the top. The room should be altogether about 30 feet long, 15 broad, 12 or 14 feet high at the most lofty part, and about 8 feet high at the northern end. Some photographers may not be able to command the space necessary for a room of the size given, but, if length and height be sacrificed, the room should not be less than 9 or 10 feet wide. The room should be kept very clean and free from dust, and for that reason it is preferable to place the sitter on oil cloth of a neat quiet pattern instead of carpet, which harbours dust.

A writer of great practical experience has very truly remarked that the success of many a photographer depends upon the fortuitous advantages of his glass house; but these fortuitous advantages depend upon fixed laws and principles which the photographer must learn, if he is still ignorant of them. To be brief, a contrast of light and shade is agreeable to the eye whether tutored or untutored; whereas uniformity of light or of shadow is very displeasing. It is not known why this is so, any more than why harmonious combinations of sounds are agreeable to the ear, or why non-coincident vibrations produce discord and are displeasing. By means of a properly arranged contrast of light and shade, a roundness and modelling is communicated to pictures, which is agreeable to the eye, and, where there is a want of this contrast, the picture is flat and un-

satisfactory. Again, where the contrast is exaggerated—where the lights are very bright and the shadows very deep—where the transition from one to the other is direct, and the line of demarcation between them is almost visible—what should be roundness becomes a complete distortion of solidity. This distortion, arising from a violent contrast, is sometimes so great as to cause a sitter to disclaim his own picture. The student should give very particular attention to the proper lighting of the model, for that, in connection with intelligent and skilful posing, will entitle him to rank as an artist as well as a mere photographer. The qualifications necessary for a good portraitist are principally embodied in these two points, and a thorough knowledge of both are necessary to get pleasing life-like pictures.

If an object be placed so that the light in one direction either brilliant or dull, falls perpendicularly upon its surface, the picture will be flat and disagreeable because there is no contrast; if the light falls obliquely the contrast will be displeasing according to its intensity, because the shadows will be elongated and distinctly marked from the lights. A single light therefore can scarcely be said to produce an artistic satisfaction.

Two equally bright lights in opposite directions, or rather, in directions at right angles to each other, are very objectionable, because they produce a bright circle of light in the eyes of the sitter which is repugnant to an artistic taste, and the picture is also flat from want of contrast.

If lights proceed from two directions at right angles to each other, or somewhere in the neighbourhood of this angle, *of which one is more brilliant than the other*, then it is possible to arrange the sitter or model so as to satisfy a cultivated taste and get a life-like portrait.

The greater the brilliancy of the light, the more unmanageable it becomes in the production of that soft merging of light into shade which in photography is so much required. It is therefore objectionable to use the direct rays of the sun in taking portraits. But during the day these rays proceed from three quarters of the compass: in the morning from the east, at noon from the south, and in the evening from the west; from the north alone in the northern hemisphere the direct rays do not emerge. But the northern sky or space is illumined by the direct light from the sun, which, by reflection and diffusion, has parted with much of its offensive brilliancy, and is rendered soft and manageable. The

principal direct light, or top light, as it is usually termed, must face the north, and the side lights must be east and west, either side light being used according to the position of the sun, and modified, if too brilliant, by the application of the calico blinds before mentioned.

The Operating or Dark Room.

THE room intended for all operations necessary to be conducted without the presence of white-light, commonly called the dark room, ought to lie contiguous to and open into the common operating or work-room of the photographer; and both these rooms ought to open directly into the glass house. As before recommended, they are to be constructed at the northern end of the gallery, each being seven and a half feet wide—this is half the width of the glass room, and about ten or twelve feet long. The work-room may be that on the left, whilst the remaining chamber is on the right, with a door in the middle of the partition between them. A double pane of yellow-coloured glass on the northern end is all that is needed; this window may be about two feet square and four feet from the ground, in order that, when the operator is standing the light whilst developing may come from below and through the negative. This mode of admitting light permits the progress of development to be distinctly watched much more effectively than by reflected light. The elevation of the pane of glass above the floor must be regulated in accordance with the stature of the operator, and his habits of standing or bending during the process, so that sometimes an elevation of two or three feet above the floor of the room will be found sufficient. The object to be gained in having the yellow glass doubled, is the total exclusion of the actinic rays which is seldom effected by one thickness of glass. Monckhoven, a great authority, recommends the total exclusion of natural light, and that the operator should work by the light of a candle or small gas jet in a yellow glass lantern or chimney. On the north, east, and south sides a shelf is constructed twelve inches wide, and three feet from the floor. In the north-west corner the pail or barrel is placed to contain water for washing the negatives: it is desirable to have the water laid on in the usual way where possible. This pail or barrel is supplied

with a brass stop-cock, such as is used for beer or wine; beneath the stop-cock, and on the floor, is placed the large wash-tub or sink for containing or carrying off the refuse dirty water. Beneath the north-west and the north-east corner there will be found abundance of space for the developing and fixing dishes, as also for the respective solutions used in these processes, and for intensifying, as, for instance, protosulphate of iron, pyrogallic acid, cyanide of potassium, hyposulphite of soda, solution of iodine in iodide of potassium, tincture of iodine, nitrate of silver, bichloride of mercury, and sulphide of potassium. Each of these solutions must be legibly labeled, always placed in the same position, and always carefully corked. As regards the solution of the sulphide of potassium, the necessity for accurate closing of the bottle which contains it is absolute, because the fumes of hydrosulphuric acid, if allowed to escape into the room, would decompose the sensitizing-bath, and injure the prints and negatives. Care must be taken also not to interchange dishes; for the cyanide of potassium decomposes the iron-salt into what soon becomes Prussian blue by oxidation of the iron, and thus renders it a difficult task to clean the dish afterwards. The first things in order on the eastern shelf are the plate-holders, leaning in their respective places against the wall; after this comes the sensitizing-bath, on an inclined frame, fixed upon the shelf. The inclination may be about fifteen degrees from the perpendicular: if it were more than this, the light particles of the undissolved iodide of silver, and of other insoluble substances, would be apt to settle upon the tender surface of the collodion, and give rise to apertures in the negative. To avoid this calamity of photographers, it is preferable to have some arrangement by which the collodionized plate can be introduced into the sensitizing bath with its collodion surface downward. For this purpose flat dishes are used with a glass or porcelain ledge on the right side to support one end of the plate, whilst the other end rests on the bottom of the dish on the left side. In this way the left end of the collodionized plate is introduced first into the bath, whilst the right end is gradually and quickly lowered by means of a silver or glass hook, until it comes in contact with the elevated ledge which is to support it. The plate is to be completely covered with the nitrate of silver when thus lowered upon its support, which need not be more than a quarter of an inch above the bottom of the dish. Naturally when the plate is in this position, the collodion is nowhere in contact with the vessel which contains it, ex-

cepting at the upper and lower edges. By making the above-mentioned ledge still more shallow, a very small quantity of the silver solution will suffice to cover the plate, and the solution can be filtered if necessary after each operation, whereby there can be but small risk of any damage from the deposition of particles of undissolved matter upon the film of collodion. In this country, the vertical or slightly inclined sensitizing baths are prefered, and consequently in most general use; in France and Germany, the horizontal baths are frequently to be met with, and are certainly to be recommended in order to avoid the trouble above alluded to.

To the right of the silver-bath for collodion-plates is the appropriate place of the horizontal dish, to contain the sensitizing solution for the paper. This dish will have a capacity to meet the requisitions of the establishment, and may contain a whole sheet, a half-sheet, or even less, as the case may be. On a small shelf two feet above this dish are placed, in stoppered bottles, the nitrate of silver solution with a small filtering-stand and funnel, ammonia, alcohol, and distilled water; and running from the dish to the southern side is constructed an inclined plane, with a semicircular groove covered or lined with plates of glass or porcelain, each one overlapping its fellow like tiles. The first one just projects over the edge of the dish. This grooved inclined plane is screwed to the eastern side of the room, and being thus tiled, is situated in the right position for receiving the droppings of nitrate of silver from the sensitized sheets when removed from the dish, and attached by pins through an upper angle to a soft wooden slip immediately above. The first sheet that is taken from the bath is fixed at the most distant point, and so that the lowest angle is just in contact with the uppermost inclined glass tile; the next is pinned close to it, until the row is complete. If the lower corners or angles of the silvered paper touch the glass, the superfluous fluid will easily flow off and down the inclined plane into the dish; if the corners curl up, it will then be necessary, with a small pad of cotton-wool or a glass rod, to remove the accumulated solution, by bringing the corner in contact with the grooved channel. By this arrangement the photographer is able to economize his time and his solution. As soon as one row is thus filled with sensitized papers, those first pinned up will probably be sufficiently dry for removal to another slip situated on the southern side of the dark chamber, thus making room for a fresh quantity of papers.

The semicircular grooves of glass can be manufactured as follows:—Take, for instance, a piece of iron plate about fifteen inches long and two inches wide, and get it hammered longitudinally into a hollow groove; next cut up slips of glass of the same length, and about an inch and a half wide. Place one of these slips of glass in the iron channel so that it lies uniformly in the middle. Now heat the iron carefully red-hot, when it will be found that the glass will soften, sink, and assume the shape of the mould. When this has succeeded, allow the iron to cool gradually, in order that the glass may be properly annealed. By arranging these cylindrical glasses so that they overlap each other about half an inch, in the form of tiles, there is no need of applying cement. Where but little printing is done it may not be worth while to adopt this arrangement, but it is well to have a dish specially placed to receive the drippings from the sensitized paper. In conclusion, the writer particularly cautions the student to avoid dirt and dust in the dark room, and to avoid the use of anything therein likely to create or collect it. And also recommends that every care should be taken in the construction of the room, so that when sensitizing, &c., no light shall be admitted into it—not even the smallest ray—except through the yellow glass. The solutions should all be prepared by weight and measure—never guess the quantities.

Work Room.

By the term work-room is meant the room in which plate cleaning, trimming and mounting prints, &c., may be done.

The bottle of collodion should be kept on a small shelf in the dark room, close by the door, in a very convenient place to seize when occasion requires. With this convenience, the plates are flowed in the doorway between the two rooms. At the north end of the work-room there should be a tolerably large window, with the lower part about two feet from the floor, flush with the upper part of a shelf or table constructed right across, from side to side. On the sides of the window-frame, on nails or hooks, hang the various sized shapes for cutting papers or photographs, as well as the different sized plate-holders,

diaphragms, pliers, scissors, diamonds, rulers, brushes, pencils, &c., used in mounting, printing, &c. On the left side of the table, on small shelves, may be kept acetic acid, nitric acid, hydrochloric acid, sulphuric acid, protosulphate of iron in crystals, distilled water, citric acid, pyrogallic acid, alcohol, pestle and mortar, stirring-rods of glass, weights and scales, graduated measure for drachms and ounces, another for minims and drachms, cyanide of potassium, hyposulphite of soda, gun-cotton, iodide and bromide of cadmium, iodide and bromide of ammonium, nitrate of silver, ammonia, chloride of ammonium, gum-arabic, gelatine, solution of gum-arabic, or starch, paste, &c., brush, spatula, carbonate of lime, acetate of soda, phosphate of soda, iodine, iodide of potassium, bromide of potassium, bichromate of potassium, and other chemical materials required for work or experimentation. The preceding articles have to be arranged on narrow shelves in the order in which they can be most conveniently laid hold of, according to their respective merits as necesary or accessory ingredients. On the right side of the window arrange the various sized glasses, already cut, both for negatives and positives, the plate-holder or vice for cleaning glass plates, rotten stone, or tripoli, alcohol, solution of salts of tartar, dilute solution of nitric acid, cotton or linen rags, piece of chamois leather, silk cloths, broad camel-hair pencil for dusting off particles or fibres from the polished glasses, triangular file, spirit lamp, box of pins, box of tacks, small hammer, large and thick glass plate for cutting out photographs, &c., scale and compasses, vignette glasses, the different sized printing frames, varnish, mats, preservers, cases, leather, black paper or velvet, &c., mounts of various sizes.

The sides of this room are furnished with wooden strips, to which photographs can be attached by pins in order to dry them after fixation and washing. The toning and fixing dishes are situated on the shelf on the west side; as are also the chloride of gold, test paper, acetate and phosphate of soda, alcohol, and hyposulphite of soda. Beneath the shelf place the tubs for washing prints, or the washing machine, which is decidely preferable. The rolling machine should be kept in this room. In drawers preserve the different sorts of paper in use. Have one drawer for dry but uncut positives, one for the cut positives, one for uncut stereographs, one for the right stereographs, and one for the left, one for card pictures not cut, and one for the prepared card

pictures. Photographic stock can be stored away on shelves on the southern end and on the sides of this room. Both these rooms are to be supplied with stoves or other means of warmth and ventilation. On the entrance door affix the sign forbidding all intrusion. Keep all visitors in the ante-chamber, which may be made as comfortable as possible. The photographer cannot perform his duties with ease if crowded with inquisitive, meddling, and talking parties; the lenses do not operate well if the air is saturated with vapour, and the health is impaired in the midst of the mixed effluvia arising from a concourse of visitors.

Apparatus, &c.

HAVING studied the requirements and arrangements of the glass and operating rooms, we must consider the apparatus necessary for producing the pictures. In procuring same, it is not always wise to go to work in the cheapest manner, so far as first cost is concerned. It frequently happens that this is the most expensive way in the long run. Without recommending the student to a lavish outlay, we advise him to get *good* apparatus. If this be not done, the student will probably meet with many failures, not attributable to his want of skill, but arising from defects in his camera, lenses, &c., which will probably dishearten him, and certainly necessitate another outfit.

For in-door work and portraiture, a double combination lens will be required. Lenses of this class (and also landscape lens) are of various sizes, and according to his requirements or means, the student will purchase a quarter, half, or whole-plate lens. If he intends to take card pictures, it will be advisable to procure a lens specially constructed for carte-de-visite work, and each lens should be fitted with the waterhouse diaphragm. The camera should be sound in every respect—should have no chinks that admit the light; and the plateholders, carriers, and focussing screen should fit properly and work easily. A substantial and firm camera-stand will be required, and a good iron head-rest that may be used either for a sitting or standing figure. A head-rest to fix on the back of the chair for sitters is not recommended. If a curtain be used

as an accessory, it should be arranged to cover the foot of the head-rest, and so hide it; or a slip a few inches high, in keeping with the background, may be used to cover it.

Glass baths will be required for the sensitizing solutions except when paper is sensitized: in that case a porcelain bath sold for the purpose must be procured. A holder to receive the plates while they are being cleaned, to avoid touching them with the fingers; weights and scales; printing frames; American clothes pegs to suspend sensitized paper to dry; porcelain baths for toning and fixing; several glass funnels, keeping one specially for each solution; graduated glass measures from 5 oz. down to 60 minims; diamond for cutting glass; horn forceps; silver meter for estimating strength of bath; glass stirring rods and bent glass rods for spreading developing solutions, or, what is better, developing dishing, which will obviate the necessity of the use of the rods and secure better results; some large and small stoppered bottles to contain solutions when not in use, and so effectually protect them from the dust; chamois leather; one or two old silk handkerchiefs; some clean linen rags, black velvet focussing cloth, and a focussing glass. A spirit-lamp will also be required.

Collodion (bromo-iodized) both positive and negative will be required; nitrate of silver, recrystallized for the collodion plate bath; patent plate glass, cut in different sizes according to requirement; protosulphate of iron; pyrogallic and gallic acids; citric acid; hyposulphite of soda; chloride of gold; carbonate, phosphate, and acetate of soda (according to the toning bath intended to be used); kaolin; cyanide of potassium; glacial acetic acid; alcohol; crystal varnishes for negative and positive; black varnish; Tripoli powder or rotten stone; nitric acid; albumenized paper; filtering paper; litmus paper; blotting paper; and various other things, if the student practises all the processes placed before him in this manual, particulars of which will be found in the chapters treating on these processes. For landscape photography it will be necessary to use different apparatus, that is, a view lens, and a camera with expanding body constructed especially for landscape work—a light strong portable tripod stand for same; and lastly, if it is the student's intention to work with wet collodion plates, a portable dark box or tent apparatus to be used in working out of doors with dry plates, will be described in its proper place. When you have got your apparatus, keep it in good order, free from dirt and dust; see that the lens is

always clean, as dirt will interfere with rapidity; be scrupulously clean with your baths and dishes; and in weighing out your chemicals mind that no particles of matter placed in the scales for some other solution than that which you are about to make remain in them. We had almost forgotten to mention that it will be necessary to get a supply of distilled water. This can usually be obtained where you procure your chemicals, or if these parties cannot supply it, they will be able to inform you where to get it. Distilled water is sometimes contaminated with a little organic matter which would interfere with the proper working of the bath. A few grains of alkaline nitrate of silver, or ordinary nitrate of silver dissolved in the water, will, if the solution be left in the sun for a few hours, cause all the organic matter to be blackened and thrown down. It must be filtered out, and the water is then ready for making the bath: common or rain-water may be used for making nitrate of silver solutions if treated in this manner. This is a wrinkle that may be of service when there is no distilled water to be got, as the expenditure of silver is very trifling.

Posing the Sitter.

In portraiture this point is a most important one, and without a certain amount of taste and good sense displayed in regard to it, no satisfactory picture can be obtained. Supposing the sitter to be attired in a becoming manner, and to possess the requisites for making a good picture, the photographer must exert himself to make the best use of the advantages so possessed; and it will depend in a great measure upon his skill in so doing, and in properly lighting the sitter at the same time, whether the portrait will be a pleasing resemblance or a miserable caricature. It is almost needless to observe that different subjects require different treatment in the posing, and require a different class of accessories; for one can hardly imagine a photographer so devoid of sense as to place a clergyman in his surplice in the midst of a mountain glen, or on the sea shore with a balcony behind him; or a sentimental looking young lady in front of a background representing the quarter-deck of a line-of-battle ship. There are backgrounds and accessories suitable for

general work, and on the other hand there are some which, although giving a good effect when properly used, should only be brought into use when they are specially suitable to the character and class of the sitter. A plain background and a curtain, although extremely simple and very common, is a very useful and very good adjunct to the picture : it may be used with almost any subject. A background representing a drawing-room with suitable accessories is also very good; but don't stand your models before it with their bonnets and hats on ; and if you make use of a landscape or marine background your sitters should not be in evening costume with low-necked dresses and swallow-tail coats. Avoid crowding accessories into the picture, as they give it the appearance of a portrait taken in a furniture broker's shop ; and be careful that the accessories, such as bookcases, pianos, balustrades, balconies, &c., are in keeping with your background. If you use what are termed profiled accessories, see that they are represented as receiving the light from the same quarter that your sitter will be lighted from. This remark applies also to backgrounds. It need scarcely be observed that when the shadow appears on the right hand side of the figure in the picture it should also be on the right hand side of the pillar or other accessory used ; and that the picture is not improved by the background representing the shadows as thrown from the left instead of from the right hand side.

Don't handle your sitter—direct him how to place himself, and if he cannot understand your instructions show him the position in which you wish him to stand, by placing yourself in it. Let it be graceful and natural—above all natural—and let it, if possible, be in keeping with the sitter's profession and character. Endeavour by conversation to ascertain the character of your sitter, and pose him accordingly. A little practice will enable you to hit upon the knack of doing this. Don't bore your sitter by too much talking; but just before uncapping the lens it may be as well to address a few cheerful remarks to him, as you may by so doing prevent the features assuming that rigid appearance so common in card photographs. Adjust the head-rest, and pose your sitter when you have your plate by the camera ready to take the place of the focussing screen, but not before ; you will thus avoid fatiguing the sitter by placing him a long time in a fixed and consequently uncomfortable position.

Collodion Positives.

There has been but little alteration in the mode of working the collodion process since its invention by Mr. Scott Archer, but its popularity continues undiminished, and deservedly so.

There are several things which the photographer must possess, and several arrangements to be made, before he can take a collodion positive. He must have a glass house, or suitable platform and screens, erected in the open air, an operating or dark room, of course, as before described, with all its accoutrements; glass, collodion, developer and fixer, must all be ready, and in their proper places; the sensitizing bath, plate holders, water-tanks, &c., all adjusted.

The manipulations necessary to the taking of a collodion positive on glass may be divided into ten distinct operations.

1st. Preparing the glass.
2nd. Coating it with collodion.
3rd. Sensitizing it.
4th. Exposing it in the camera.
5th. Developing the picture.
6th. Fixing the picture.
7th. Drying the plate.
8th. Colouring the picture.
9th. Varnishing the picture.
10th. Mounting the picture.

Preparing the Glass.

Glass suitable for the photographer must be free from flaws on the surface or in the mass, flat, and quite transparent. It can be procured already cut, of the various sizes required, or the photographer may cut it himself from plates of the proper quality. There is a particular knack to be acquired in order to cut with a diamond; the line made by a diamond on glass is like the cut made with a sharp razor on a piece of soft wood: it is by no means a scratch. A diamond is wedge-shaped, and its edge not a straight line, but a curved line; the edge first makes an incision, and the wedge splits its way as the diamond proceeds.

The position of the edge has to be found out, and the diamond studied, before you can cut with it, and not scratch with it. If you are determined to cut your own glass, prepare a glazier's board and a ruler for this purpose, and mark off with marks the different sized glasses used in the art, as one ninth, one sixth, one fourth, one half, four fourths, and stereoscopic, &c., plates. The student is not advised to cut the glass, as he can always procure it of the sizes required, but the hints as to cutting will be found useful.

Next see that your glasses, so far cut, are of a right size for your plate-holders; for it is very annoying when the film is sensitized to find that the plate is either too big or too small for the holder. Never omit this precaution.

The next duty is to take the glass in the left hand, and with the right hand to run a file along each edge of the cut glass, beginning at the left-hand corner, and proceeding to the right-hand corner all the way round; the glass is then turned round to the other side, and its edges are treated in the same manner. The object in view, by thus abraiding the edges, is, firstly, to take precautions against the cutting properties of such sharp edges; and secondly, it is found that the collodion film adheres better to the edges of the glass when it is so prepared.

If you are provided with a vice or plate-holder sold for the purpose placed right in front of you in an appropriate place on the table or bench in the work room (and such a vice is a very useful accessory), the plate is fixed in this horizontally. Now take the bottle containing prepared rotten-stone, or Tripoli powder, covered at the wide-mouthed orifice with a piece of gauze, instead of being closed with a cork, and dust a small quantity of the powder upon the centre of the plate; then drop upon the powder on the plate from ten to twenty drops of alcohol, and with a piece of flannel rub the mixture about from side to side and in the centre until the surface of the glass is perfectly clean. A clean piece of the flannel is then used to remove all the remaining particles of the preparation, after which the plate of glass is seized with a silk handkerchief or piece of wash leather,* so that the fingers do not come in contact with the glass, which is turned round, clamped, and its other surface is

* In these cleaning operations, cotton gloves may be worn; it will then be necessary to use one cloth only. Gloves, cloth, and leather, should be free from grease, and scrupulously clean.

cleaned in like manner. Both sides being now apparently clean, again seize the plate with a clean silk handkerchief in the left hand, remove it from the vice, and, holding a clean silk cloth or piece of wash leather in the right hand, go round the edges, remove all dust from them, and from either side, then breathe upon either side; if the breath forms a uniform film, and vanishes uniformly without any irregularity, the surfaces are cleaned. By this system of friction the glass becomes electrified, and small fibres of cotton or silk and small particles of dust are very apt to be attracted to the surface; these must be removed by a flat sable or camels' hair pencil. The plate is now ready for the second operation, viz.:—

Coating with Collodion.

Holding the plate horizontally, by the smallest portion possible of the left-hand corner, between the thumb and the first finger of the left hand, pour over its surface, beginning at the right-hand corner, a sufficient quantity of collodion to cover it; when it is supposed that there is sufficient collodion poured out, lower the nearest edge and the nearest right-hand corner, so that the collodion can, by the inclination of the plate, be made to flow uniformly over the surface, and its superfluous quantity can be drained into the collodion bottle. A wide-mouthed bottle, containing a couple of ounces, will be found to be an appropriate shaped vessel to contain the collodion for present use when the pictures are small. Collodion is apt to indurate around the orifice of the bottle: and if this dry film is not carefully removed every time, it may cause trouble by flowing off in fragments along with the collodion, and thus spoil the collodion film. This trouble is obviated in a great measure by the use of what are denominated "cometless vials:" they are made for this special purpose. If the collodion is thick and glutinous, it will be no easy matter to obtain a film on the glass, free from ridges. In such a case an additional quantity of alcohol generally renders the collodion thinner, less glutinous, and more structureless. Supposing the film to be even, free from ridges, from wooliness, and specks of every kind, allow every drop of the collodion to drain off, then wait until it has set, which will be effected in a very short time. It is very easy to ascertain, by a touch of the finger on the right-hand corner, whether the film is sufficiently dry or not; if it no longer yields beneath a slight touch, the plate is ready for the next

operation. By the way, I may here remark, that it is by far the most advisable plan for a practical photographer not to manufacture his collodion, unless he be in some degree a chemist, acquainted with the neatness and accuracy of chemical manipulations, and have plenty of leisure time. As an amateur, he can seldom succeed in preparing at all times when required a reliable specimen of collodion; and to prepare small quantities of collodion, as well as of any other chemical compound, is seldom an economical affair. Besides this, there is no necessity for such a sacrifice of time and money in a country like this, where collodion can be purchased of so superior a quality for all the ordinary operations of the practical photographer.

Sensitizing the Film.

When the film has indurated or become set, place it upon the ledge of the dipper, and lower it in one continuous and rather quick motion into the sensitizing bath. Take care that no actinic rays get to the bath during this operation. After three or four minutes raise the dipper a moment, and examine the collodionized plate; if the film is still bluish, and as if covered with streaks or specks of oil, lower it again, and let it remain until the collodion has a yellowish-white creamy appearance, and is free from all oiliness. Withdraw it from the bath; seize the right-hand corner between the thumb and finger* of the right hand; allow the silver solution to drain off thoroughly into the bath; with a piece of blotting-paper remove all specks of collodion from the back of the plate, taking care not to disturb the collodion along the edges of the plate or on the film side; remove the last drop of silver from the lowest corner, place it in the plate-holder, and close the slide and the shutter. Previous to this, the camera is supposed to have been fixed before the sitter, and the picture focussed as to size and position on the plate. It is supposed, moreover, that the surface of the ground glass and the collodion film are exactly at an equal distance, when placed in the groove, from the back lens. As before observed, unless the picture is correct on the ground glass, free from all haze, bright, sharp, and the light uniformly subdued, it will be very unlikely that the collodion picture will be a successful one; in fine, the image on the film will never be better than the one on

* Positive bath—nitrate of silver 30 grains, distilled water 1oz., rendered slightly acid with diluted nitric acid; iodize by leaving a collodionized plate in it all night.

the ground glass where the lens has been accurately adjusted; and furthermore, that if the picture on the ground glass be clear, sharp, distinct, and agreeably contrasted with light and shade, you may legitimately expect a similar favourable result on the collodion. Be careful, therefore, in bringing every part of the model into as accurate a focus as possible—be careful in the management of the light. The pose of the sitter and final adjustment of focus should be made when you have the prepared plate in the holder beside the camera, ready to be inserted in place of the focussing screen. There is less chance of tiring the sitter by so acting, than there would be if you were to pose him before preparing the plate.

Exposing the Plate.

Place the cap on the lens; let the eye of the sitter be directed to a given point; withdraw the ground-glass slide; insert the plate-holder; raise or remove its slide; desire the sitter to remain perfectly still, and then uncap the lens. Give the exposure necessary, which will vary with the light, the quality of the lens and chemicals, and then cover the lens. Down with the slide gently, but with firmness; withdraw the plate-holder and yourself into the dark-room, and shut the door. It is quite impossible to give the precise time the plate should be exposed; it will vary from 5 to 60 seconds or more. Practice and observation are the only means the student has of getting at this. We shall have something more to say on this subject a little further on.

Developing the Picture.

Placing the plate-holder, still containing the plate in an inclined position, against the wall in its regular and proper position, open the shutter and take out the collodion plate carefully, so as not to injure the film, by inserting the nail of the first finger along the cavity on the upper part of the plate-frame, and drawing forward the plate so as to let it fall into the left hand, the plate is then seized by the left hand corner between the thumb and the finger. In this position the plate can easily be covered with the developing fluid in precisely the same way as with collodion, only the operation must be much quicker, in order to cover the surface without producing any lines of stoppage, which invariably happens unless the plate be flowed all at once. When the plate is large, it is preferable

to take it by the right hand corner, and lay it in the left hand corner of a gutta-percha dish whose lateral dimensions are about twice as large as those of the plate. Then, holding the dish in the left hand, incline the right side downwards, and pour into it a quantity of the developing fluid. By a quick motion the fluid can be made to cover the surface of the plate in one continuous flow. As soon as every part is thus covered, the plate is taken out with a quantity of the solution upon it, and the operation watched. By proceeding in this way, two difficulties are avoided: the first of which consists in washing away a portion of the nitrate or iodide of silver, &c., on that part on which the solution is allowed to fall if the first method be adopted, whereby a diminution of reduction is observable in this part: secondly, you avoid the liability of forming islands and curved lines of demarkation where there is the slightest stoppage in the flowing of the developer. Supposing the plate to be covered, however, you then watch proceedings. If a bright silver-white film be desired, it is well to make use of a slow developer, such as is used for negative purposes, containing, in addition, a few drops of solution of nitrate of potassa and nitric acid. Take, for instance, the following, which is found to work well with a white background, giving a roundness of figure more like that of a daguerreotype:—

FORMULA FOR DEVELOPER.

Sulphate of Iron	2 drachms.
Water	8 ounces.
Acetic Acid	2 drachms.
Alcohol	1 drachm.
Nitrate of Potassa	½ drachm.
*Nitrate of Siver Solution ...	30 drops.
Nitric Acid	12 drops.

The image will gradually appear, and if the time of exposure has been right, you will be able to observe the three grades of contrast in the development, that is, dark parts or shades, middle tones, and lights. You will see, moreover, whether the relative conditions of the collodion and the silver-bath are in good working order, by the mode in which the development takes place. If the whole surface of the collodion plate

* Previous to iodizing the bath solution set aside an ounce or two for this purpose.

soon assumes a foggy, milky, or clouded appearance, with but faint contrast between the lights and shades, (and knowing that the camera is quite impermeable to light excepting through the lens,) you may fairly conclude one of two things, either that the time of exposure was too long, or the condition of the materials was not normally good. Of these difficulties I will speak shortly. By carefully watching the development it is not difficult to observe how the shades increase in density, how, in fine, the picture becomes more and more developed; and particularly the photographer can distinguish the regular shading of the background. At last the development arrives at its culminating point; if it were to proceed any further, the background and the transparent parts would begin to be foggy; the contrast diminishes, and finally the picture is spoiled. The rule is this: the moment the image is complete and the background has received its first shade, pour off the remaining part of the developer, and wash immediately and thoroughly by allowing a small stream of water to play upon the surface until every trace of the iron is removed, wash also the posterior side of the glass in like manner. We now proceed to the sixth operation.

Fixing the Picture,

The fixing solution is composed of

Cyanide of potassium	...	...	1 drachm.
Water...	...	...	...	...	4 ounces.

Have the solution ready; with the right hand place the collodionized plate in a gutta-percha dish held in the left hand, and pour upon the developed image a quantity of the above solution in a gentle stream, until all the white or yellow iodide of silver has been completely dissolved, taking care in the meanwhile that the fluid is kept moving backward and forward, so as to preserve uniformity of action. After this operation, wash the plate again in many waters on both sides, and until all traces of the cyanide are removed. Holding the positive now over a piece of black velvet in such a position by a window that the impingent rays shall reach the eye, the quality of the picture can be determined. The picture must be quite clear; the shades dark, almost black; the lights brilliant and white; and in every respect the lines and points must be sharply defined. If there is no regular gradation of light into shade, but almost one mass of shade, and the picture is offensively black, the

time of exposure was too short or the development not carried on far enough; but if in this case the development had been continued until the retrograde action had set in, then certainly the time was too short. The remedy in such a case is extremely simple; rub the picture out and take another with a longer exposure. If, on the contrary, the picture is hazy, or foggy as it is technically denominated, and the lights and shades too much blended or too little distinct from each other, and the development was rapid, and a difficulty presented itself in discriminating when the reduction began to assume a retrograde action, in such a case it may be confidently concluded that the time of exposure was too long. The remedy of course is known. But the defects just mentioned might have been caused by carrying on the development too long; and it would be very proper to attribute these defects to this cause, if the development had been slow and carelessly watched. But if the haze and fogginess commenced almost as soon as the developing solution was poured upon the surface, you would be justified in ascribing the cause of this veil over the picture to an abnormal condition of the silver-bath or the collodion. This evil indicates, as a general thing, alkalinity in either one or the other, or in both, and can be remedied by rendering either one or the other acid. It may be caused by a new bath and a new neutral silver solution.

Remedy for Fogginess.

If the collodion is nearly colourless and new, this material is probably the cause of the want of contrast in the picture, of the feebleness in the development, and, it is possible, of the veil that covers the whole plate. Take some highly-coloured old collodion and add it to the new in the proportion of one drachm in ten, and try another picture; or add to the collodion, tincture of iodine, that is, a solution of iodine in alcohol. In either case, most likely, under the circumstances, an improvement will be manifest. If the picture is not yet perfectly clear, proceed in the same direction, that is, add more of the old collodion or of the tincture of iodine. If the bath is quite neutral or alkaline, it will be well to drop in a minim or two of nitric acid. To do this, take a drachm of distilled water and drop into it five minims of nitric acid. The mixture contains about sixty drops, of which six drops will contain about half a drop of nitric acid. Begin, therefore, and add six drops of the solution to the

bath, and keep doing so until the picture is perfectly satisfactory. I prefer myself keeping the bath as nearly neutral as possible, and to apply the remedial action to the collodion, by adding free iodine or old collodion, of which the former seems by decomposition to liberate an acid in and on the collodion film in proper quantity, at the right time, and in the proper place; and the latter, that is, old collodion, effects the same result, because it has already undergone the decomposition of the pyroxyline that is called ripening, and contains the materials for producing intensity and for avoiding fogginess.

In taking collodion positives, beginners are very apt to develop the plate too long, as well as frequently to expose in the camera too long. The right time in both instances can be attained only by practice, after having consulted the best instructions. As soon as the picture is distinctly visible by reflection, stop the development; if it is then faulty, the time was either too long or too short; too short if the shades are altogether too black, and transparent by transmitted light, and *vice versâ*, if the reverse.

Supposing the picture to be correct and satisfactory, we proceed next to the next operation.

Drying the Plate.

The operation is performed by means of the large flame of an alcohol lamp, or by the radiating heat from a stove. Holding the plate by the left hand corner, between the finger and the thumb of the left hand, first allow all the water to drain off at the nearest right hand corner, by inclining the plate for this purpose; then, holding the lamp in the right hand, move the flame gently over the back of the plate, so as to avoid fracture, beginning at the top and proceeding from side to side, and gradually downward, until the film is thoroughly dried. A second inspection now, by viewing the picture, as before, on a dark background, and by reflected light, decides whether the positive is good, tolerable, or indifferent, because now the final colours of the shaded parts are attained. These shaded parts are of a bright, white silvery hue, with the developer above given. Some tastes are more gratified with a more subdued contrast in which the whites are more deadened. This can be effected by making use of a much more rapid developer, and by omitting the nitrate of silver, and the nitric acid. For this purpose the following formula will be found practicable.

Formula No. 2 for Collodion Positives.

Sulphate of the protoxide of iron	4 drachms.
Acetic Acid...	6 drachms.
Water	8 ounces.
Alcohol	2 ounces.
Nitrate of baryta	2 drachms.

Mix intimately, and filter before using. Prepare fresh every day.

The next step which the artist has to take, consists in removing any particles that may have settled upon the surface of the picture, and in colouring the cheeks, hands, and drapery where required. Dry colours are used; those of Newman are regarded as the best.* Very little colour will produce an agreeable effect. With a fine sable or fitch pencil, take a small portion, and rub it gently on either cheek, on the lips, the hands, and forehead; then brush off the extraneous quantity, or shade the colour off from the centre of the cheeks, for instance, to the edges. On the lights of the drapery the requisite colouring may be laid on in like manner. This operation of colouring is frequently performed on the varnished surface. Finally, with a large broad sable pencil, remove all loose colouring particles. And now the positive is ready for the ninth operation, viz. :—

Varnishing the Picture.

Whilst the plate is still warm, uniformly warm from the drying operation, flow it with the purest and most transparent crystal varnish, precisely in the same manner as the plate was covered with collodion. The operation must be performed with dexterity and care; with dexterity in order to avoid all ridges caused by stoppage, and with care to avoid loss of varnish by escaping to the posterior part of the plate, upon the fingers, and upon the sides of the bottle, and the floor. The dried or hardened varnish on the back of the positive may be removed by a tuft of cotton wool, dipped either in alcohol, benzole, or chloroform, according as the resins in the varnish are dissolved in either of these menstrua. Do not apply any heat from a large flame on the back of the plate before the varnish has dried, otherwise the ethereal fluid in which it is dissolved

* Students will do well to get Newman's "Harmonious Colouring as applied to Photographs." It is a very useful little book.

will take fire in many instances, and spoil the varnished surface. When the film is somewhat dry and indurated, and not quite smooth, heat may be applied carefully, in order to remove the unevenness or the want of brilliancy.

Varnishes for Collodion Pictures.

Formula No. 1.

Copal	1 ounce.
Pure benzole	15 ounces.

Dissolve and filter through Swedish or ordinary filtering paper.

Formula No. 2.

White stick lac	3 ounces.
Picked sandarac	3 drachms.
Alcohol, spec. grav. 815 ...	40 ounces.
Oil of bergamot	6 drops.

Dissolve the resins in the alcohol by means of a water-bath and filter. This varnish is immediately ready for use; and, like all varnishes, is the best when new.

Formula No. 3. *Crystal Varnish. Soft Copal Varnish.*

Finely powdered Dammar resin	5 ounce.
Benzole	50 ounces.

Set aside in a closed vessel for a week, shaking the mixture from time to time for a day or two; then allow the insoluble gum to subside. Draw off the supernatant liquid, which, when clear, is ready for use. The collodion plate must be quite dry and cold when this varnish is applied, and the latter is allowed to dry spontaneously.

Formula No. 4. *Amber Varnish (with Chloroform).*

Amber, in fine powder... ...	3 ounces.
Chloroform	50 ounces.

Shake the mixture from time to time for eight or ten days, and then filter. This varnish, like the preceding, is poured, like collodion, upon the cold plate, but with great dexterity, because it dries very rapidly.

Formula No. 5. *Amber Varnish (with Benzole).*

Amber	3 ounces.
Benzole...	50 ounces.

Heat the amber first in a close vessel to a temperature of about 570° Fahr., when it begins to soften and swell, yielding white fumes. It is then dissolved in the benzole. This varnish too, is flowed upon the cold plate, and allowed to dry spontaneously. These two last-mentioned varnishes are more especially adapted for negatives.

If it should happen that a collodion picture becomes somewhat spoiled by the cracking of the varnish, it is recommended, if its restoration or preservation be of great importance, to take the following method :— first, ascertain whether the solvent of the varnish on the plate be alcohol, chloroform, or benzole, by dropping on one corner a minute drop of each of these menstrua, to ascertain which dissolves the varnish. Next take a tin box, somewhat larger than the picture, about one inch deep; at the bottom of this box solder a ring of tin, about half-an-inch wide, of the same shape and nearly of the same size, as a support for the glass plate; pour a small quantity of the solvent on the outside of the support, place the plate, collodion-side upward, on the ring, cover the box as nearly air tight as possible with a piece of glass, and place it in a water bath; the vapour of the solvent will soon cause the varnish to swell, and the edges of the cracks to coalesce. As soon as this end in view is accomplished, the plate is carefully withdrawn, and when cool is again varnished with a similar varnish.

The plate having been varnished with a transparent resin varnish, we proceed finally to the last operation.

Mounting the Picture.

We have now to make a background for the positive of some black material, which may consist of a piece of black velvet, black paper, etc., of the same size as the plate : or we may apply a coating of black varnish either to the collodion surface, or to the posterior surface of the glass. If the varnish on the background be applied to the collodion side, the picture is not laterally inverted, but it loses considerably in transparency by the intervening collodion; in consequence of this inconvenience the background is generally placed on the side of the glass without the collodion,

Formula No. 1. *For Black Varnish,*

Oil of turpentine	50 ounces.
Asphaltum	2 „
Canada balsam	4 drachm.

Formula No. 2. For Black Varnish.

Benzole, or coal-tar naphtha	50 ounces.
Asphaltum	2 „
India-rubber	½ „

Formula No. 3. For Black Varnish.

Camphine	50 ounces.
Pulverized bitumen	10 „
White wax	2 „
Lampblack	1 „

Mix these ingredients together, and dissolve by a gentle heat; afterwards filter and preserve in a well-corked bottle.

The glass positive, sometimes denominated an *ambrotype*, is now finished. It remains only to fix it in a case or frame. In the first place a piece of very transparent and unblemished glass, of the same size as the picture, is thorougly cleaned and its edges filed, as for collodion purposes, and all particles are brushed from its surface. It is then placed in a preserver, over this comes a mat, next the positive; the two latter are then firmly folded within the flexible edges of the preserver, and the compact mass is finally adjusted in its appropriate case.

Collodion Negatives.

THE step to be next taken by the student in acquiring the art of photography is to learn the means of obtaining collodion negatives on glass.

A collodion negative is an actinic impression in which the different parts of the image are, as in the positives just described, laterally inverted, and when viewed by transmitted light, the shades are where the lights ought to be, and *vice versâ*. It is the matrix from which positives are obtained by direct contact, either on glass or on paper, as also with the aid of the lens in the ordinary, or in the solar camera. Most of the details of the operations in the negative process are precisely the same as in the positive process.

The glass is filed, cleaned, and flowed with collodion, as before directed.

It may be sensitized, too, in the same bath, and then exposed; or a bath may be specially prepared for the production of negatives.

Formula.

Pure re-crystallized nitrate of silver	1 oz.
Distilled water	12½ „

Mix, and saturate with iodide by shaking up some collodion with the solution. Try a plate, and if the picture produced is not satisfactory—there being no assignable reason for the failure, except as regards the bath—test same with litmus paper. If the paper turn red, there is free nitric acid in the bath which must be neutralized by adding a little oxide of silver in solution. Let the bath stand a few hours—filter, then add to each ounce of bath solution one drop of glacial acetic acid. The bath will now probably work in a satisfactory manner; but if there be any tendency to fog, a little more acid must be added carefully. Let the time of exposure be from ten to twenty seconds in the glass room, probably more; much depends upon the proper adjustment of the light, and its concentration by the lenses. The object in view is to obtain much more actinic action, not only on the film, but through the film, so as to produce a denser metallic reduction for the shades, which in the positive are lights. To guard against the liability to fogging, a much weaker and more acid developer is used than in the positive process. The developing is carried on as long as the shades increase in density, by transmitted light. It is an advantage in this process to have a small square of yellow-coloured glass, situated lower down than the position of the negative, as you hold it for the operation of development, in order that the light may come from below, and thus through the glass. By this means the progress of development is best observed. If fogging sets in, or the density seems to be stationary, or even to retrograde, the negative is developed as far as circumstances in the present instance will permit. If the density of the shades is so great as to prevent you from distinguishing objects through them, and these shades are regularly tempered down through the intermediate tones to the bright lights, and these lights are still clear and transparent, it is very possible that the image is sufficiently negative, and that you have succeeded in your undertaking. It is absolutely necessary that you should know what you have to do before you can depend upon what you do, or rely on definite results. A true negative is just what I have described. If the lights

are not clear and transparent, with sufficient detail, of course, intermingled—if the shades are transparent, and not comparatively opaque, so much so as to allow the print of a book to be read through them; or if there are no intermediate tints, but your negative is all black and white—then you have not succeeded; your negative is faulty. We will suppose, however, that the three gradations of shades, middle tones, and lights exist, but that the intensity of the shades is not strong enough; there is a general weakness in the negative, and your object is to push on the development, which is found to be ineffectual without producing a haziness or fogginess over the whole plate; the conclusion to be drawn from this circumstance is that the time of exposure was too short. Another sitting may remedy the evil. On the contrary, if when the developer is poured on, the reduction on the shades is very rapid, and this reduction commences, rushes with rapidity into the lights almost before you have time to stop it, you may fairly conclude that the time of exposure was too long. But a bad developer sometimes may produce very much the same effect; for, if the proportion of the iron salt, in comparison with the acid and the water, be great, fogging and rapid reduction will certainly be the result. As before remarked, a much weaker developer is required in the preparation of a negative than in that of a positive, and a proportionately larger quantity of acid to check its action, until the proper density of opacity is attained in the shades. (I use the words shades and lights in the negative, to represent what they really are, and not what they produce on the paper print: shades are dark and opaque; lights are thin and transparent.)

We do not aim to obtain brilliant white silver reductions on the negative; for the colour, or metallic brilliancy, is altogether a matter of little consequence; on this account we use no silver solution or nitric acid in our negative developer. Where the time of exposure is not necessarily required to be very short, a pyrogallic acid developer produces a very pleasing negative.

Negative Developers.

Formula No. 1. *Iron Developer.*

Sulphate of the protoxide of iron	... 4 drachms.
Water	... 8 ounces.
Acetic acid	... 1½ ounces.
Alcohol	... 6 drachms.

Formula No. 2. Pyrogallic acid Developer.

Pyrogallic acid	3 grains.
Water	2 ounces.
Acetic acid	2 drachms.
Alcohol	6 drops.

The negatives which produce the softest prints are those which are produced by the first development, where the time of exposure and the action of the reducing agents have been in such relatively due proportion as to produce the three gradations with a proper amount of opacity in the shades. This proportion cannot always be determined beforehand, because of the variability of the light, and its actinic powers, of which we know as yet absolutely so little. We cannot determine the reason of the widely diverse action of light at six in the morning and six in the evening, or at the vernal equinox and the autumnal. In consequence of this want of definite knowledge of the prime cause that institutes the active physical changes in the iodo-sensitized collodion film, it will frequently happen that the developed image is not perfect; the shades are not endowed with sufficient opacity. Fortunately in such cases we possess means whereby these shades, middle tones, and detail in the lights can all be in relative proportion rendered more opaque, and as much more opaque as may be desired. The process by which this end is attained is denominated the Intensifying or Re-developing Process.

The image having been developed as far as possible in accordance with the rules laid down, the plate is thoroughly and carefully washed on both sides, and freed entirely from every trace of nitrate or developer. Cyanide of potassium in solution, the formula of which is given at the end of the positive process, may be employed to remove the undecomposed iodides or bromides, care being taken not to continue the action of the solvent too long, nor to apply it in too concentrated a condition, lest the fine markings of detail are dissolved off at the same time. Because, as already mentioned, cyanide of potassium is a reducing agent, as well as a fixing substance, and giving a silver salt so acted upon a reguline appearance, it is regarded as the fixing agent proper for collodion positives; whereas, owing to the properties possessed by hyposulphite of soda as a fixer alone, and not a reducer, and because its solvent action is not so violent as that of the cyanide, it is properly recommended to fix negative pictures.

Fixing Solutions for Negatives.

Formula No. 1.

Hyposulphite of soda	5 ounces.
Water	10 ounces.

Formula No. 2.

Cyanide of potassium	1 drachm.
Water	5 ounces.

In case the image is fixed with the first formula, that is, with hyposulphite of soda, the plate requires to be washed with the utmost care; for if any of the hyposulphite of silver is left in the film, it will become manifest after the drying of the film, sometimes at the expiration of months, by the formation of a crop of crystals on the surface that completely ruins the picture. As soon as washed, the plate is ready for operations quite distinct from those in the positive process.

Intensifying or Re-developing Process.

Formula No. 1.

Iodine	1 grain.
Iodide of potassium	1 grain.
Distilled water	1 ounce.

Formula No. 2. *For the stock bottle of the same material.*

Iodide of potassium	1 drachm.
Water	2 ounces.
Iodine to saturation.	

Intensifying Process.

Take from ten to twenty drops of this solution to each ounce of water, and flow the developed plate with it. This operation can be performed in the diffused light of day. The plate must be kept in motion all the while, and the fluid poured off and on, in order to obviate all irregular deposition. The solution will gradually lose colour, whilst the film in the meantime assumes a gray or yellowish-gray hue. If the negative does not require much additional opacity in the shadows, it is not necessary to carry on the depositing operation further than the gray film. The plate is now washed again.

Intensifying Operation.

Formula No. 1. Nitrate of Silver.

Nitrate of silver	30 grains.
Distilled water	1 ounce.

Take three drops of this solution with two drachms of water, and cover the plate with the fluid. Pour the fluid off and on several times.

Formula No. 2. Pyrogallic Acid. (Stock.)

Pyrogallic acid	12 grains.	keep in a dark place.
Acetic acid	1 ounce.	

Formula No. 3.

Of this take	1 drachm	For immediate use.
Water	7 drachms	
Alcohol	10 drops	

To two drachms of No. 3, add ten drops of No. 1; mix intimately by shaking, and then pour it upon the plate, and keep it in agitation. The shades will soon increase in blackness and opacity. The operation is carried on to the greatest advantage by holding the negative over a light reflected from below, as in the dark room, or near a doorway receiving its light from the sky. Stand sufficiently far back, and sideways of the door, so that the light does not shine upon the negative directly from the sky, but is received as it is reflected upwards from the floor, &c., below. The shadows will grow darker and darker, and the process has to be stopped as soon as the opacity is sufficiently dense. Experience alone can tell you exactly when to stop. The denser the background in the negative, if a white screen were used, the whiter the print will be; but the opacity may be so great as to require an hour or two for the subsequent printing operation, which is inconveniently long. A certain connection exists, therefore, between the negative effect and the positive printing effect afterward, which experience has to teach; and even if you do not execute your own printing, this connection must not be lost sight of. In parts that must really appear white in the paper, the opacity must be dense enough to prevent you from reading print through them; taking this for your guide, separate such a part in the picture, keep your eye steadfastly upon it as it increases in darkness, and when

it has arrived at the point indicated, pour off the intensifying solution, and wash very thoroughly. It sometimes happens that the film becomes contracted by this operation, or that the fluid gets between the glass and the film, and thus the latter becomes loosened, and is liable to peel off. Careful experience will teach you how to retain the collodion in its place.

Whether many or few prints have to be taken from a negative, it is requisite to varnish the film when dry. But almost all varnishes have a penetrating effect, like oil of turpentine on paper, and thus diminish the opacity of the negative. This has to be taken into consideration, and the negative must be intensified, in accordance, deeper than would be required were it used without varnish. The property of a varnish suitable for such purposes, must be a sufficient hardness of film to prevent scratches; it must not become soft or tacky when exposed to the heat of the sun; it must be free from any liability to cracking by contraction, perfectly transparent, of as little penetrating power as possible, and free from all action upon the film.

Varnish Formula.

White Lac	4 ounces.
Picked sandarac	4 drachms.
Alcohol (concentrated)	60 ounces.
Oil of bergamot	20 drops.

Dissolve by the aid of a water-bath and filter.

To obviate the diminution of opacity by means of the varnish, I frequently flow the plate with a dilute solution of gum-arabic or gelatine, which is allowed to dry, and the plate is varnished afterwards.

Printing, Toning, and Mounting.

THE next thing to be considered is obtaining positive prints from the negative. There are several kinds of paper used for this purpose, but albumenized paper is that in most general use. Enamelled paper is now adopted to a limited extent; but, although it gives extremely fine prints, the difficulties attending its use, and other causes, restrain a more general application of it for portraiture, for which it is especially

adapted. Plain salted paper is also used; generally speaking, however, it is only used in printing by development.

We will first describe the method of printing with albumenized paper.

The paper used in this process is usually French or German, and is termed *papier Rive* and *papier Saxe*, and is in each case of two qualities, thick and thin. *Papier Rive* is preferred by some photographers as giving prints of great vigour and brilliancy, but the writer has found the German paper more satisfactory on the whole, being free from a defect very common with certain samples of Rive paper, viz., blistering. The paper is prepared with a certain quantity of chloride to each ounce of albumenizing solution; this quantity varies from 5 to 20 grains per ounce. The general opinion is that the salting of the paper should be in proportion to the strength of the bath used, and in this the writer concurs, for the paper, to give vigorous prints, should contain a certain proportion of three different compounds of silver, viz., the albuminate, the chloride, and free nitrate; and these proportions can only be obtained by a certain harmony or equality between the salt in the bath and the salt in the paper. It has also been ascertained by experiments that rapidity of printing under the same conditions of light is in proportion to the amount of chloride contained in the paper, and the strength of the sensitizing bath. Paper containing a specific quantity of the chloride to each ounce of albumenizing solution can be obtained of most makers, and it is recommended that a paper containing about 10 grains of chloride of ammonium or sodium be used with a 60-grain bath in summer, and a paper containing about 15 grains of chloride floated on a 100-grain silver bath be used in winter. There is a bath composed of nitrate of silver and nitrate of soda recommended by some photographers, but as the results obtained appear to be very uncertain, and as the writer has not found it at all satisfactory, he does not recommend this bath. For those who like to try it, formulæ are given at the end of this chapter.

Having procured the requisite paper, and made the bath in accordance with the instructions above given, the next step is to sensitize the paper by floating it on the silver solution. A proper porcelain bath must be used for this purpose and kept exclusively for it. These baths are made of various sizes, and the photographer will of course select one

according to his requirements. Having cut the paper into suitable sized pieces, and filled the porcelain bath with the silver solution, one end of the paper is placed (albumenized side downwards, of course,) on the solution, and the rest of the paper is gradually lowered from the end first placed on the bath until the whole surface is in contact with the solution. This must be done carefully, the object being to avoid bubbles, the existence of which will cause small insensitive spots on the paper, rendering it valueless for printing purposes. The paper must remain on the bath solution from three to five minutes. Three minutes will be found sufficient in summer, and five will be found the best in winter; a low temperature causing the chemical affinity to be less active than a warm one. After the paper has been floated a sufficient time it is raised from the bath by a pair of horn or bone forceps (common tweezers tipped with sealing wax will do), or a japanned pin may be used to raise it by the corner; it is allowed to drain a little and then hung up to dry by means of an American clip or clothes-peg, a small piece of blotting paper being placed at the lowest corner to absorb the superfluous silver solution. We may here observe that an instrument termed an "argentometer," or "silver meter," must be used to ascertain the strength of the bath when made, and from time to time during use, as its strength rapidly diminishes. It will be found advisable to make the bath slightly acid in the warm weather by adding about one drop of nitric acid to each ounce of solution, as the whites are better preserved thereby, and the paper less liable to spontaneous colouration in the dark. Acetic acid is recommended by some writers, but the preference is given to nitric acid, as the formation of acetate of silver is thereby avoided. The paper being quite dry and the negative properly varnished, a printing frame must be procured, and in the dark room the negative is placed in the frame, varnished side inwards, and the sensitized surface of the paper is placed on the varnished or collodion side of the negative; the frame is closed up, and the negative must be placed in the light for printing. For most negatives direct sunlight may be used in printing, unless the weather be very warm; it is then to be avoided, if possible, on account of the liability of the glass to become fractured and of the varnish to melt, and the negative and paper becoming inseparably attached. In the case of vignette printing the use of diffused light is recommended, as also in the case of weak negatives. It is of considerable

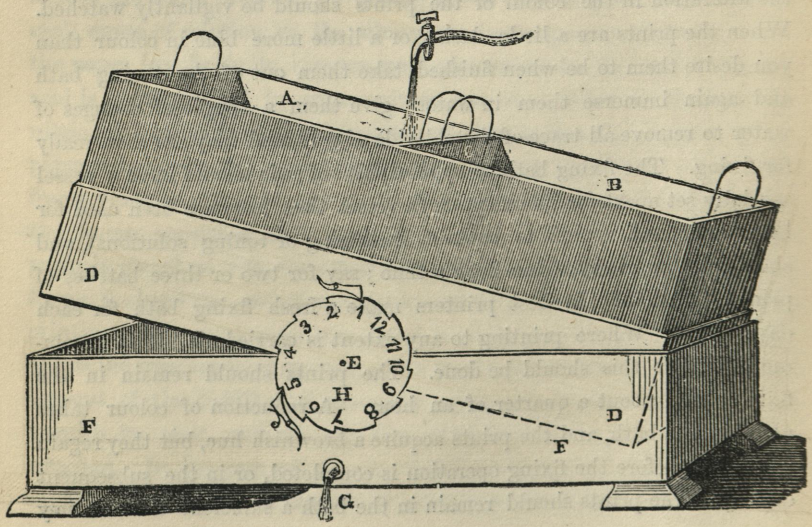
importance that the paper and negative in the printing frame should be in close and perfect contact; the sharpness of the print depending in a great measure upon this. The print should be a little overdone; that is, there should be an appreciable bronzing of the shadows and colouring of the lights, as in the toning and fixing operations the print loses in depth. The progress of the printing may be watched by occasionally lifting up one half of the joined back of the printing frame. This should be done either in the dark room where there is plenty of yellow light, or in a place imperfectly lighted with white light. The high lights of the picture are thereby preserved in their purity, which would not be the case if the examination were to be made in the full light of day.

When the printing operation is completed the paper positive is removed from the frame and stored in the drawer set apart for its reception, there to remain until the day's work is finished. It is then necessary to wash the prints in two or three changes of water to remove the free nitrate of silver previous to their immersion in the chloride of gold toning bath, which should be prepared ready to receive them as they come out of the last washing water. The prints should be carefully placed in the toning bath, care being taken to prevent them overlapping and touching each other, as this would cause irregular toning. The toning solution should be kept in motion by occasionally tilting the dish, and the alteration in the colour of the prints should be vigilantly watched. When the prints are a little darker or a little more blue in colour than you desire them to be when finished, take them out of the toning bath and again immerse them in water; give them a couple of changes of water to remove all trace of the chloride of gold, and they are then ready for fixing. The fixing bath of hyposulphite of soda should have a vessel specially set apart for its reception (a vessel that has once been used for hypo being quite unfit to contain sensitizing or toning solutions), and should not be used for too long a time; say for two or three batches of prints. Some of the best printers make a fresh fixing bath for each day's work. Where printing to any extent is carried on, it is recommended that this should be done. The prints should remain in the fixing bath about a quarter of an hour. A reduction of colour takes place in this bath, and the prints acquire a brownish hue, but they regain the colour before the fixing operation is completed, or in the subsequent drying. The prints should remain in the bath a sufficient time or they

will not regain their colour, and before proceeding to free them from hypo they should be examined to see that the fixing is complete. If, on examination, *by looking through them*, yellow patches are observed, the prints must again be immersed in hypo, as there is still unchanged chloride of silver to be dissolved out. If this be not done the prints will gradually discolour in the different parts where it exists.

The next step is to free the prints from the hyposulphite of soda; and this must be done thoroughly by copious washing in running water, or in frequent changes of water. They may be washed freely two or three times in different changes of water, and afterwards soaked in four changes of water, remaining one hour each in the first two, and two hours each in the last lots of water. The prints must not touch or overlap each other in the water. This washing, as carried on in the old style, entails a vast amount of trouble, and is frequently ineffective in securing the permanency of the prints; for the student will mark that unless every trace of hypo be removed from the print it will certainly fade sooner or later. To save trouble and to secure the perfect removal of the fixing salt, several very ingenious self-acting washing machines have been invented. Of these the most effective is that invented by

FIG. 1.



Mr. C. Hanbury, junior, a member of the Photographic Society of London. In order that the reader may avail himself of the invention of this gentleman, we will give a description of the apparatus, with its most recent improvements, in his own words :—

Fig. 1 represents the apparatus in perspective.

A B is a gutta-percha trough to receive the pictures to be washed. It is divided into two compartments by the partition C.

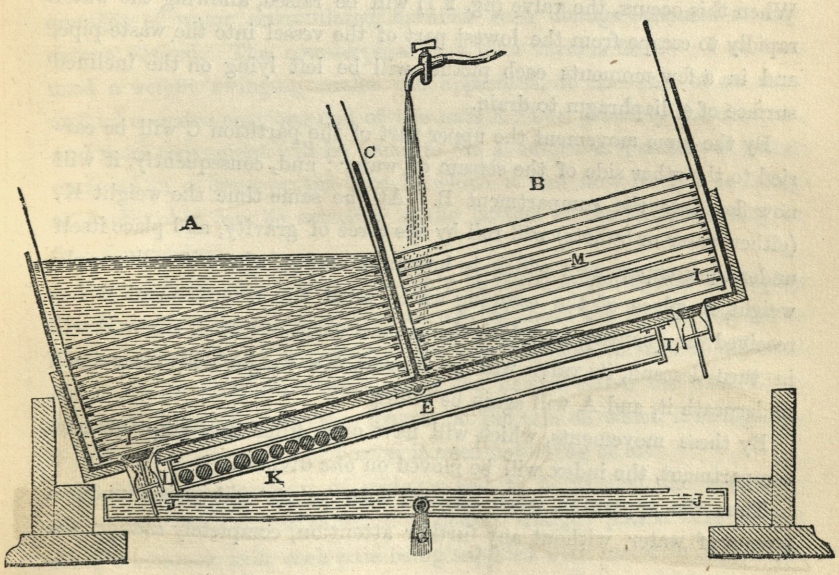
D is a wooden tray carrying the gutta-percha trough.

E is a metallic axis attached to tray D, and turning in gudgeons fixed on a strong wooden frame F. From this it will be seen that the tray D, and the trough attached to it, will rock with the motion of a see-saw upon the centre E.

H is a cog-wheel, into the notches of which one stop, attached to the tray D, works, and another attached to the stand F, thus causing the whole to advance a notch each time the trough makes a complete oscillation.

Fig. 2 shows the apparatus in section. The letters indicate the same parts in each figure.

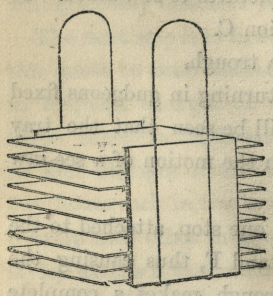
Fig. 2.



I I are conical valves opening into the compartments A and B.

When the trough is made to rock, as either end descends, the valve in it is raised by striking at the point J within a pipe, which discharges from the two ends by a common orifice at G.

Fig. 3.



K is a moving counterpoise, formed by a number of bullets rolling in a metal tube, L L; or, as the bullets make an unpleasant rattling noise on each movement of the machine, it is better to half fill this tube with water.

M, moveable diaphragms or shelves, carried in a loose frame fitting into each trough, upon each of which a print is to be placed.

Fig. 3 represents the diaphragms and the frame which carries them.

From the above description, it will be evident that when the axis of the apparatus is placed under a tap, if the water is allowed to flow, it will fall into the compartment which is uppermost (fig. 1 A), where it will accumulate until its weight causes that end of the trough to descend. When this occurs, the valve (fig. 2 I) will be raised, allowing the water rapidly to escape from the lowest part of the vessel into the waste-pipe, and in a few moments each picture will be left lying on the inclined surface of a diaphragm to drain.

By the same movement the upper part of the partition C will be carried to the other side of the stream of water; and, consequently, it will now flow into the compartment B. At the same time the weight K, (either water or bullets) will roll by the force of gravity, and place itself under the compartment which is becoming empty, where it will supply weight, in place of the escaping water, until the compartment B has received the quantity for which the apparatus is adjusted, when it will in turn descend, its valve will be opened, the weight will place itself underneath it, and A will again be filling.

By these movements, which will have once filled and emptied each compartment, the index will be moved on *one* division.

Thus the apparatus, when charged with prints and placed under a stream of water, without any further attention, completely *changes* the

water at definite intervals, allowing it to escape from the lowest part of the vessel. It exposes the prints *singly* to the action of the water. It *drains* them in an inclined position between each change. It *registers* the number of changes, and consequently the quantity of water passed over the pictures, thus enabling the operator to employ a definite and uniform amount of washing ; and it causes sufficient motion among the pictures to prevent the adhesion of bubbles to their surface.

Experiment proves that, other things being the same, it washes in less than one-sixth the time of the ordinary tray, and with a proportionately smaller quantity of water.

In its simplest form the apparatus may be made without either valves or weight, merely having a hole at each end, through which the water may escape. But it then becomes necessary considerably to increase the length of the trough, and the angle through which it moves, in order to admit of the accumulation of sufficient water ; and this is objectionable, because the long descent causes a violent agitation of the water, and also because the water whilst accumulating lies too exclusively in the angle at the base of the partition.

These inconveniences are entirely overcome by the moving counterpoise, by means of which the angle of motion may be *reduced*, and the quantity of water accumulated between each change *increased* to any extent desired. The counterpoise may take various forms. I at first used a weight swinging under the apparatus, at the end of an arm around a centre near one end of the axis E ; but probably the cheapest and most convenient will be found to be a sufficient quantity of water enclosed in a brass or tin tube, in which it can flow freely : as many of such tubes can be attached to the bottom of the trough as may be found necessary.

On the large scale it may probably be found advantageous to employ a swinging weight attached to a rod carried above the trough, parallel to the partition (C). The power of the counterpoise can then be adjusted either by its absolute weight, or by the height above the axis (E) at which it is placed, or by the length of the arm on which it swings, or, if sufficiently elevated and heavy, it need not swing at all.

If *very* large numbers of pictures had to be washed, the apparatus might take the form of a series of double troughs placed side by side along a common axis, each pair being supplied with water by a jet from

a common supply-pipe, placed parallel to the axis, above them. Or it might be simply a double trough, prolonged in the line of the axis sufficiently to take any required number of frames carrying diaphragms (fig. 3).

In the construction of the apparatus it will probably be found sufficient if the trough moves through an arc of 20°, which will give 18 divisions on the index-wheel. The motion in the apparatus shown is 30°, and is unnecessarily great. It may be found useful to have a float-board to prevent the water slopping over when the full end descends.

In the apparatus made for me, Mr. Wood has ingeniously added a second index-wheel in front of the first, but having one tooth more, and an opening in its face, which shows, one at a time, a second series of figures on the first wheel, and thus it very prettily records the number of revolutions of the first wheel; but such a provision is scarcely required.

I have tried numerous plans for keeping the pictures apart. My first attempt was to use straw mats of the kind employed for covering cream cheese. Then, with much trouble, I got some thin sheet gutta percha corrugated so as to present a surface like the straws. Experiments soon proved that the plain gutta percha without channels answered the same purpose and retained less water, and was less liable to injure the pictures; but it has the great disadvantage of adhering very closely to the paper after draining, forming a mass which floats bodily, and only loosens again very slowly. Thus I was led to adopt diaphragms having an independent support. On the small scale, glass can be used. It may slide in metal grooves, such as are used for plate-boxes. On the large scale, probably tin plates may be used. The space between the diaphragms need not exceed the thickness of patent plate glass. As they occupy an inclined position, when the water enters it drives the air before it; the stronger solution gravitates to the lowest part of the trough; and as no wave-motion can occur in such a cell, when the water is discharged it ebbs out, leaving the paper smoothly laid on the incline to drain. The support of the diaphragms directs the water, flowing from between them, towards their ends, and thus prevents any tendency to float the prints down their inclined surfaces. Owing to the prints rising in water they have a slight tendency to cling to the under surface of the diaphragms. But when *perforated* diaphragms are used the papers rise and fall with the water, and float about in the little space between the

snelves with the utmost freedom, leaving apparently nothing to be desired. Unfortunately zinc cannot be used, but ebonite in thin sheets, with perforations about $\frac{1}{4}$ of an inch diameter, appears admirably to answer the purpose.

If we now imagine Mr. Ponting's experiment with the ink to be repeated with the arrangement here recommended, we shall see at once that the first change would empty out the ink, the second would rinse the trough, and the third would show no trace of it; and thus a few pints of water and a few minutes in time would effect what he found to require in a stationary tray 80 gallons of water and $3\frac{1}{2}$ hours.

But it is worth while to consider a little more closely *how* the removal of soluble salts from the surface and substance of paper is really effected.

If we could cause streams of water to permeate every pore, and to carry with them by mechanical force all the matter which could be either dissolved or suspended, then the process of washing would be definite, absolute, and perfect, and the duration of the operation would only depend on the rapidity of the streams. But we possess no such power. In the first place, a stream of water but very slowly removes water which is already adhering to a solid. Every chemist knows how surprisingly insufficient even the *repeated* rinsing of a test-tube often proves. In the circulation of the blood through the capillaries, and in the flow of any fluid through a small tube, the liquid immediately in contact with the pipe appears to be stationary, and is known to physiologists and physicists as the *still layer*. The phenomenon is no doubt due to the fact that particles of water are more powerfully attracted by those of most solid bodies than by each other, as is shown by the concave surface assumed by water in all ordinary vessels.

These considerations show how easily the particles of water in actual contact with a picture may allow others to flow over them without becoming themselves detached. By draining, however, a large portion of this adhering water is removed; and hence every experiment shows a much larger proportion of hyposulphite in the last *drainings* than in the *bulk* of the water discharged at each change. But for the removal of the hyposulphites from the *tissue* of a picture we are wholly dependent upon the property which soluble salts possess of *diffusing* themselves through the solvent which surrounds them; and thus it is that the process of

washing becomes indefinite, comparative, and, in theory, only approximately perfect. All we can do is to secure the conditions most favourable for diffusion.

What these conditions are is thus stated by Professor Graham, whose beautiful researches almost created this important branch of chemical physics. He says, "The general law of diffusion appears to be this:—*The velocity with which a soluble salt diffuses from a stronger into a weaker solution is proportioned to the difference of concentration between two contiguous strata*" (Graham's Elem. of Chem. ii. 608). The arrangements just described appear to secure these conditions with the least possible labour; but I am anxious that it should be clearly understood that *time* must ever remain an important element in any process depending on diffusion.

Each change of water subdivides the quantity of the salts in solution, and at first greatly weakens the solution left in the paper; but for that very reason, in accordance with the law just stated, diffusion goes on more and more slowly, the difference between the solution in the paper and the contiguous stratum of pure water becoming less and less. Hence the great practical importance of using a moderately small stream of water, and of continuing the process for a considerable time after all appreciable traces of the salts have disappeared.

The principle of applying water in the most efficient manner to some primary purpose by making use incidentally of its own mechanical power on some plan analogous to the one I have adopted, may probably admit of application in other processes. But if, by lessening the labour of the conscientious and the temptation of the unscrupulous, the suggestions here made should promote the better washing of photographs, and thereby the reputation of the art, my hopes and intentions will be fully realized.

When it is found that all the hyposulphite of soda has been removed from the prints, they are taken out of the water and hung up to dry. This hanging up is effected by some printers by pinning the prints by one of the corners to ledges running along a wall in the work-room set apart for that purpose, by means of black japanned pins; others use American clothes' pegs (especially useful where large sheets of paper are used), others have japanned hooks fixed to the wall. The pinning up answers very well, and is the simplest mode of proceeding. When the prints are

nearly dry they must be taken down and trimmed ready for mounting. It is recommended that the prints should not be quite dry, but just damp, when about to be mounted, as they do not curl up so much, and are more manageable in the pasting operation, &c. The prints are cut down with a very sharp knife to the desired shape, by being placed under a piece of glass supplied for the purpose, called a *guide*. These guides or shapes are of various sizes, and are square, oval, dome or cushion shaped. When the print is properly trimmed, it may be mounted on a suitable card by means of starch paste or india-rubber paste; the former being recommended. In mounting card pictures the following contrivance will be found extremely serviceable—securing neatness and cleanliness in the picture, and comfort to the operator:—Get a deal frame constructed 4½ inches long, and 3¼ inches wide, having an opening in the front *just* capable of receiving a trimmed card picture, and an opening at the back just capable of receiving an ordinary mount for same. In fact, get a picture-frame made capable of receiving a carte de visite portrait, the opening in front of which will only show the paper print—not any of the card mount—and the opening in back of which will be precisely the length and breadth of the card mount. Have a backboard made precisely the size of the card mount, and face it with cotton velvet. Place the card on which you intend to mount a picture on this backboard, cover it with the frame, paste the exposed card surface, drop your trimmed print on to same, remove the frame, dab the print down with a clean cloth, and the mounting is completed. The fingers need not be soiled: there will be no difficulty in getting the print in the right position, and there will consequently be a saving of time and trouble in securing neatness by the use of this machine, as compared with the old plan of mounting without any such adjunct. If the student cannot construct the frame himself, a carpenter will make it for a shilling or eighteenpence. This plan of mounting was communicated to the *Photographic Times* by Mr. Hockley, a photographer residing at Hammersmith. When the mounted print has become quite dry, it should be finished off by passing it through a rolling machine, which will impart a glaze to its surface, having an effect similar to that imparted by varnish to a painting. It gives the print a sharp, clean appearance, brings out the detail, and renders it generally more vigorous in character than it appeared in its rough state. These machines may be had of various sizes, from a

card picture to a whole sheet of paper, with burnish steel, or silver plates, or polished glass beds.

Sensitising Baths for Albumenized Paper.

Formula No. 1.

Nitrate of silver	...	...	1 ounce.
Distilled water	...	...	7 ounces.

Add one drop of nitric acid to each ounce of this bath solution. The amount of silver contained in the solution is about 62½ grains to the ounce.

Formula No. 2.

Nitrate of silver	...	...	1 ounce.
Distilled water	...	...	4½ ounces.

Formula No. 2 is intended for heavily salted paper, and for the cold and comparatively dark days. It contains about 100 grains silver to each ounce of solution.

Formula No. 3.

Nitrate of silver	...	...	40 grains.
Nitrate of soda	...	...	40 grains.
Distilled water	...	...	1 ounce.

Formula No. 4.

Nitrate of silver	...	...	20 grains.
Nitrate of soda	...	...	80 grains.
Distilled water	...	...	1 ounce.

Toning Baths for Positives on Albumenized Paper.

Formula No. 1.

Chloride of gold (pure)	...	...	1 grain.
Distilled water	...	...	8 ounces.

Carbonate of soda to neutralize acidity of the gold salt.

Formula No. 2.

Double chloride of gold and sodium			2 grains.
Distilled water	...	...	6 ounces.
Carbonate of soda	...	...	3 grains.

Formula No. 3.

Chloride of gold	...	...	2 grains.
Distilled water	...	...	8 ounces.
Phosphate of soda	...	...	100 grains.

Formula No. 4.

Chloride of gold	...	...	3 grains.
Acetate of soda...	...	...	1½ drachm.
Distilled water ...	...	...	8 ounces.

Neutralize with chalk.

Toning baths prepared according to formula Nos. 1, 2 and 3, can only be used once. A toning bath prepared according to formula No. 4 may be used over and over again until exhausted. Litmus paper is used to test these baths for acid in the same manner as with the silver bath. It is advisable to use the baths slightly warm, and when bath No. 4 is used it is advisable after the toning is finished, and before the bath is put away, to render it slightly acid by the addition of a little diluted hydrochloric acid, neutralizing it with chalk previous to again toning prints in it. The strength of the bath is preserved a longer time by this means, and the bath may be kept in use for an indefinite length of time by the addition of neutral chloride of gold, to replace that quantity absorbed by the prints that have been toned in it.

FIXING SOLUTIONS.

Hyposulphite of soda	...	...	2 ounces.
Water	...	...	12 ounces.

Keep a piece of chalk in the hypo-solution to neutralize acidity.

The sulphocyanide of ammonium has been recommended as a fixing agent, but as yet it has not been generally adopted.

Sulphocyanide of ammonium		...	1 drachm.
Water	...	...	12 ounces.

Printing on Enamel Paper.

ENAMEL paper is a paper coated with a composition of albumen, &c., giving it a very smooth glossy surface resembling glass. Prints obtained on this paper are exceedingly vigorous and sharp. The mode of printing

on this paper is similar to that pursued with ordinary albumenized paper. The sensitizing bath is composed as follows :—

Nitrate of silver	... 80 grains.
Distilled water	... 1 ounce.
Citric acid	... 1 grain.

Print till the shadows are bronzed : then wash, tone and fix as with albumenized paper. The prints must be trimmed for mounting before the paper is quite dry, otherwise the enamel is likely to crack. They are mounted and rolled as before described. There is more trouble in securing good results with this paper than with ordinary albumenized paper, but with care extremely fine proofs may be obtained on it.

On Printing by Development.

PRINTING by development is analogous to the operation of producing a collodion picture by the agency of a reducer ; and the same materials in general are employed in the two branches of the art. It is extremely useful in the production of solar camera pictures, and is also adopted instead of the ordinary method when the light is dull and feeble.

The first operation to be described is salting the paper, which may be either Rive or Saxe. There are several formulas for salting ; some operators preferring one and some another. There is the formula for salting with a chloride, with a chloride and bromide, with an iodide, and with the nitrate of uranium. We will give them in the above order, with all the details of the printing, &c., appertaining to the processes to which they belong.

Formula for salting with a chloride—

Chloride of sodium	100 grains
Hydrochloric acid	6 drops
Distilled water	12 ozs.

Immerse the paper in this mixture for two or three minutes, and then take it out and dry.

The sensitising solution for this paper is

Nitrate of silver	1 oz.
Citric acid	8 grains
Distilled water	8 ounces

The paper it is desired to sensitise must be floated on this solution for about three minutes, and then dried by suspending by the corner by means of a varnished pin, or by suspending on a cord by what are termed "American clips." All the fluid that accumulates on the lower side or on the corners must be removed by means of blotting paper. When the paper thus sensitised is moderately dry it may be exposed under the negative, or, if you are enlarging, on the screen of the solar camera until a faint image appears. With a negative in direct sunlight the exposure will be about three or four seconds; in diffused light about a minute or more must be given. As soon as the print is sufficiently distinct, it is withdrawn and laid upon a piece of glass somewhat smaller than the paper, picture side upwards; two opposite edges of the paper are folded beneath the glass, and in this position the paper and glass together are placed on the left side of a capacious developing dish.

The developer is composed of—

Pyrogallic acid...	12 grains
Citric acid	6 grains
Water	6 ounces

Of this solution take sufficient to cover the paper. Inclining the dish downwards to the right side, pour in the solution: then raising the right side, cause the fluid to flow evenly over the whole surface of the print. It is of the greatest importance there should be no stoppage in the flow of the developer, otherwise lines and markings will occur, as in a collodion plate.

The development commences and proceeds as rapidly as on a collodion plate, and requires an equal amount of vigilance and care. As soon as the print appears sufficiently vigorous, the development must be stopped by pouring off the solution and washing at the tap. The washing must be performed effectually and carefully, and the prints are then ready for fixing.

The fixing solution is composed of—

Hyposulphite of soda ...	1 ounce
Water	16 ounces

The prints must be immersed in this solution until the whites are perfectly clear; and the time required for this will vary from ten minutes to half an hour. They are then taken out and submitted to the regular process of washing, in order to remove every trace of the hyposulphite of soda, and secure the permanency of the prints.

The picture may be toned with the ordinary alkaline gold bath. If the toning proceeds too rapidly, the bath must be reduced in strength by the addition of water.

The formula for salting the paper with a chloride and bromide is as follows:—

White of egg	10 ounces.
Distilled water	15 „
Chloride of sodium	1 drachm.
Bromide of potassium	1 „

Dissolve the salt in the water and add the solution to the white of egg or albumen. This mixture has to be beaten up into a froth, and allowed to subside several hours in a cool place. The clear supernatant liquid is decanted carefully, and filtered from the deposit into the appropriate dish for salting operations.

The papers are floated in the ordinary way upon the surface of this bath for about three minutes, and then hung up to dry on cords by means of American clips, or pinned up by the corner. When the drying is completed, the papers are put into a long tin box, which is inserted in a deep kettle of boiling water, care being taken that none of the water gets access to the paper, but that the paper is submitted, through its whole length, to the heat of steam. The operation would be still more effectual if hot steam could be brought into contact with the albumenized surface; the thing intended being the coagulation of the albumen. The omission of this part of the operation must not deter the student or operator from trying the process; the results will not materially be changed, because the coagulation can be effected in the sensitizing bath.

Formula for Sensitizing Bath.

Nitrate of silver	1 ounce.
Distilled water	12 ounces.
Citric acid	3 drachms.
Alcohol	1 ounce.

The paper must be floated on this bath from two to three minutes, and then allowed to dry as usual. An exposure of from eight to ten seconds in full sunlight will be sufficient; but in a weak light as many minutes may be required. The picture must be visible in all its details, or nearly so, before it can be said that the exposure has been long enough.

The developer is composed of—

Gallic acid	10 grains.
Distilled water	4 ounces.

The operation of development is best performed in a glass or gutta-percha dish; the print is first moistened and then placed on the bottom of the vessel, to which it adheres. The developing fluid is poured into the inclined right-hand side of the dish, and is flowed over the print almost instantaneously by quickly moving the dish into a horizontal position; if any part remains uncovered, a slight quick motion will easily bring the fluid over the part, or a bent glass rod may be used to spread the fluid over the part in question. The development proceeds with great rapidity; and when the exposure has been about right, the development of the image will be complete in two or three minutes. In very cold weather it is better either to use a stronger bath or to warm the bath previous to use, by floating the vessel containing it in hot water. We may here remark that gallic acid in solution is very apt to become mouldy by keeping, and consequently, a small piece of camphor or a drop of oil of cloves is mixed with the bath to prevent this kind of decomposition. An under-exposed picture developes very slowly, and a long continuance of the action of the acid renders it uniformly dark-coloured, without any gradation of tone. On the contrary, an over-exposed picture is developed with great rapidity, and has to be removed from the bath quickly to prevent it assuming a dark colour over the whites. If printed deep enough in the shadows, in such a case the lights would in the meantime become completely spoiled. The best prints are those in which all the details are thoroughly and rather slowly brought out in the printing. When the development is completed the prints are carefully washed, and fixed in the following solution:—

Hyposulphite of soda	1 ounce.
Water	20 ounces.

The prints should remain in this solution about a quarter of an hour

and must then be thoroughly washed in several changes of water. After this proceeding, if the tone is not satisfactory, the prints may be immersed in the following toning bath :—

Chloride of gold	1 grain.
Distilled water	10 ounces.
Alcohol	2 drachms.

Add sufficient carbonate of soda to neutralize the acidity of the gold salt, and do not use the bath until a couple of hours after mixing. The temperature of the bath should be about 60 deg. or 70 deg.

We will next give the particulars of a process in which the paper is prepared with an iodide. The formula for the salting solution is as follows :—

Solution No. 1.	Nitrate of silver ...	... 80 grains.
	Distilled water ...	... 4 ounces.
Solution No. 2.	Iodide of potassium	... 1 ounce.
	Distilled water ...	... 4 ounces.

These solutions, when made, are to be mixed together. When this is done a yellow precipitate will be thrown down, which is iodide of silver. A concentrated solution of iodide of potassium is then added until the precipitate is dissolved, but not after that object is attained. The bath is then ready for the paper, which may be floated on it in the usual manner for about three minutes, or until it lays flat on the solution. After this it is allowed to soak in common water for an hour or so, care being taken that all the pieces of paper receive an equal amount of washing. The surface of the paper thus prepared assumes a very uniform but pale yellow colour. The papers are again dried, when they are ready for the sensitizing bath, which is made as follows :—

Nitrate of silver...	25 grains.
Acetic acid	1 drachm.
Distilled water	25 ounces.

The papers are floated on this bath for two or three minutes, then taken out and hung up to dry. It is almost needless to remind the student that these operations must be performed in a place into which only yellow light is admitted. Whilst the surface is still somewhat moist, the paper so prepared is exposed beneath a negative or on the screen of the solar camera for a few seconds when the light is good,

and for half a minute or longer when the light is dull. No visible image is produced by this exposure; but the print is developed by pouring upon it in the manner already indicated a saturated solution of gallic acid containing about a third of its quantity of the aceto-nitrate of silver solution above mentioned. If the development proceeds very slowly, the exposure has been too short; if, on the contrary, the development proceeds with extreme rapidity, the exposure has been too prolonged. As soon as the picture is brought out in all its details it is immersed in water and thoroughly washed, the object being to remove every trace of gallic acid. The prints must after this be immersed in a solution of 2 ounces of hyposulphite of soda to 10 ounces of water, to which 2 grains of chloride of gold have been added, in order to fix and tone them.

The prints do not change much by immersion in this solution if the exposure has been sufficiently long; but if the prints have been under-exposed, the dark colour will become pale and red. If the shadows do not assume a dark colour in the developing solution, this defect may be attributed to the want of aceto-nitrate of silver in the gallic acid; and as a rule the aceto-nitrate must be gradually added where the development or intensity relax. The gold may be omitted from the fixing solution and after fixing, the picture may be toned, as described in the process, with a bromide and chloride.

The next process to be described is that in which the paper is salted with the nitrate of uranium. It is necessary in this process that the paper used should be kept in the dark room, or excluded from light, for several days previous to its employment. It is then floated without any other preparation on the following bath :—

Sensitizing Bath.

Nitrate of uranium	2 ounces.
Distilled water	10 ounces.

After being floated on this bath for three minutes, the paper is removed, allowed to drain, and then hung up and dried. Paper prepared in this way will keep a long time if properly protected from the light.

The time of exposure required by this paper of course varies with the intensity of the light, from one to ten minutes being required in sunlight, and from a quarter of an hour to an hour in feeble diffuse light. When the exposure has been well-timed, the image is faintly visible.

There are two developers for paper prepared with nitrate of uranium :—

Developing Solution No. 1.

Nitrate of silver	2 drachms.
Acetic acid	4 drops.
Distilled water	4 ounces.

The development of the prints immersed in this bath proceeds very rapidly. Immediately on immersion the picture appears, and all the details are brought out with great velocity. As soon as the development has advanced far enough, the prints are plunged into water, and thus washed and fixed at the same time.

The following developer is even more rapid than No. 1, and the rules which apply to the silver developer apply also to—

Developer No. 2.

Chloride of gold	10 grains.
Hydrochloric acid	1 drop.
Distilled water	12 ounces.

There is also a method of printing with the salt of uranium, in which bichloride of mercury is the developing agent. In this method the paper is floated on a bath composed of—

Nitrate of uranium	2 ounces.
Distilled water	20 ounces.

It must remain on this solution the usual time, be dried, and then exposed under the negative. After the proper exposure is given, it is developed with—

Bichloride of mercury	3 grains.
Distilled water	6 ounces.

The prints must be passed through this solution, and then washed very carefully; after which they are immersed in the following bath :—

Nitrate of silver	1 ounce.
Distilled water	6 ounces.

When the image has acquired the requisite strength the prints are taken out, thoroughly washed, and then hung up to dry.

Instantaneous Photographs.

In commencing this chapter it is necessary to inform the inquiring student that no new or secret method is to be described, but that all those wonderful instantaneous productions which must have frequently delighted his eyes and fired his ambition are produced much in the same way as the most complete failures of the most unsuccessful meddlers. He will therefore see that if the same materials are used in each case it must follow that success in this, as in every other branch of photography, is dependent, not upon secret processes, but upon attention to all the little and apparently unimportant points of detail in every part of his operations. We would therefore advise the student eager to succeed in this most fascinating department of photography, to work well and long at the manipulatory details of the preceding chapters, and on no account to venture out of doors until he can with constant success produce perfect negatives at home. When this most desirable end has been attained, we would advise him to try pictures from some upper window commanding a range of not less than 100 yards; never mind the prospect,—let it be of chimney tops, for even these most uninspiring objects can be made extremely interesting to him as studies of light and shade when tried under the varying conditions of morning and evening light, and the monotony will be frequently broken by the eagerness to get into the picture some beautiful but rapidly changing cloud effect. In this kind of preliminary practice the pupil will acquire much to help him in his after and more important ventures, for he will soon ascertain the limits that confine his operations. The pupil should now provide himself with a tent or dark box. For pictures larger than 8½ by 6½ undoubtedly a tent is more convenient than a dark box with sleeves, but for plates 8½ by 6½, and for smaller sizes, the dark box, to our thinking, possesses many advantages. To begin with: whilst the tent renders necessary other packages for chemicals, plates, &c., &c., the dark box can be so contrived to carry them all. In a properly constructed dark box the water tank may be made to hold all the chemicals needful for a long day's hard work, and when packed may be as conveniently carried as a gentleman's portmanteau, whilst the camera,

if properly constructed for out-door work, can be strapped on the legs of the tripod and carried on the shoulder.

It is so important in amateur operations to be independent of help. The writer of this chapter has frequently carried all the apparatus needful for a hard day's work many a long mile, and has felt none the worse for it the next day.

Having determined upon the kind of manipulating box or tent desirable, the pupil should now put it up in any open space that may be convenient at home, and should work in it several times, until he gets quite used to it. Having done all this to his entire satisfaction, the pupil may now set about the preparation of the solutions specially needed for instantaneous operations, and may begin with the bath, for which the best triple-crystallized nitrate of silver should be procured. Let him take 2 ounces of the silver above mentioned, and dissolve it in 5 ounces of distilled water: should there be the slightest indication of milkiness it is a proof that the water is not pure, and therefore not fit for the purpose; for it will give him much after-trouble to get the bath into proper working order. If, however, the solution remains perfectly clear, add a very small quantity, say 5 grains of iodide of potassium; a yellow precipitate will be immediately formed, which is iodide of silver: if, however, the solution be well stirred with a glass rod, the precipitate will be re-dissolved. Now proceed to add the remainder of the water, making 24 ounces in all, when the milkiness will again return. After allowing it to stand a short time the milky precipitate should be carefully filtered out. If the silver and the water be perfectly pure, the bath should give with a good collodion of a pale straw colour a perfect picture at once, but should it not do so, but give a fogged picture, with streaks in the direction of the dip, it must be returned to a bottle, and a small quantity of carbonate of soda, say 5 grains, should now be added. After well shaking the bottle, put it in the sun for several hours. On examining the contents after this operation, the solution will be found slightly discoloured, and on closer inspection small dark-coloured particles will be found floating about, indicating some organic impurity in the silver or water. The solution should now be carefully filtered, and poured out again into the bath, and a picture tried. The negative will be, doubtless, grey, and veiled on the surface, and the image faintly looming out through the fog. If, however, the fourth of a drop of nitric acid be

added, and well incorporated by the agency of the dipper, the bath will give, after a little rest, a perfect picture.

Remember here to be very careful in the addition of nitric acid to the bath; for though with a bath of the strength given above a large quantity may be added, and clean, bright negatives obtained, they will be so thin that it would be almost impossible to bring them up to the printing point. The best plan is, take a small stoppered bottle perfectly clean, and fill it with a solution made of distilled water 1 drachm to 1 drop of nitric acid. If the bottle hold 16 drachms or 2 ounces, 16 drops of nitric acid will make it of the right strength. Be careful to have the best nitric acid, which should be quite colourless. It is necessary to be very particular about all these trifles, for success entirely depends upon it. Having now got the bath perfectly in trim, proceed to make the developing solution. For this purpose the double sulphate of iron and ammonia will be found better than the ordinary proto-sulphate of iron; 10 drachms of this should be dissolved in a pint of distilled water, and an ounce of the best glacial acetic acid afterwards added. With the bath quite new, no alcohol will be needed to make it flow, and when, after working some time, the addition of alcohol becomes necessary, be careful to add it sparingly, for too much produces the same evil as too little, viz., oiliness on pouring on the developer.

To intensify the image, the pupil will need a solution made as follows :—

Proto-sulphate of iron	5 grains.
Citric acid	10 grains.
Water...	1 ounce.

Also, in a small dropping bottle, a stock of weak nitrate of silver solution, which must contain no iodide, and therefore must not be old bath solution, but had better be made specially for the purpose. The strength is comparatively unimportant, but about 20 grains of silver to the ounce of water will be the right strength.

The fixing solution had better be cyanide of potassium half an ounce to the pint of water. It is better always to have this solution rather weak. Hypo-sulphite of soda offers many advantages over cyanide as a fixing agent. It does not lower the density of the negative so rapidly as does the cyanide, and is besides quite harmless; for the poisonous

fumes from cyanide, especially when immediately under the nose in the close heated atmosphere of a dark tent, tell with serious effect upon the system after a long day's work. The great objection, however, to hypo-sulphite of soda, is the immense amount of water necessary to remove it entirely from the film. This is a serious drawback to its use in instantaneous photography, for water, especially near the sea-side, is frequently a very scarce requisite. This may appear strange, but it is true. One frequently finds

"Water, water, everywhere,"

but not a drop fit for photographic purposes. It is also sometimes necessary to intensify the negative still further after fixing. Now, it is extremely difficult to intensify without producing stains when hypo-sulphite of soda is used. As therefore, on the whole, we give the preference to cyanide of potassium, it must be used with great care. If the picture is well washed after development it may be fixed in the open air, and thus much of the ill effects of cyanide will be removed.

The best kind of camera for out-door work is one that can be used for stereoscopic or pictures $7\frac{1}{2}$ and $4\frac{1}{2}$ at will. If it be provided with a movable partition, and have also an extra front for a single or triple view lens, it will be found a most convenient instrument. When wanted for stereoscopic pictures, the centre partition should be inserted in the camera, and the front for two lenses be put on, but when pictures the full size of the plate are needed the partition must be removed, and the front for the single lens must take the place of the other. Glass plates of the same size may be used in each case, for it is much more convenient to use large plates for stereoscopic pictures than to employ the old size, for with glasses $7\frac{1}{4}$ by $4\frac{1}{2}$, besides the ease with which clean pictures may be obtained, there is room to choose the best part of the picture, for it frequently happens that some little point of importance in the making of the picture can be introduced, which would have been lost had a smaller plate been employed. The best lenses for stereoscopic work will be a pair of single lenses of about 5 inches focus, or double combination portrait lenses $3\frac{1}{2}$ inches back focus. With the former greater uniformity of definition will be given, but they will be considerably slower. The portrait lenses will have given greater sharpness with a larger aperture, but the centres will be much sharper than the sides of

the picture. This defect need not be very apparent, for with a little management it will scarcely be noticed. A little experience in focussing will teach the pupil to choose his subject, wherever possible, so that prominent objects come to the sides of the picture, and that it will never do to place the sharpest focus on an object in the centre of the picture if it happen to come near the foreground, unless it be something of such importance that the rest of the picture may be made quite subordinate to it. For single pictures $7\frac{1}{2}$ by $4\frac{1}{2}$, a view lens for whole plates should be used, or the triple lens. The latter will give the greatest angle; and will also do better for groups taken out of doors. Having now described the equipment needful for a day's venture, we will assume that all is packed up—that the bottles are all well packed in the tank—that the plates are perfectly cleaned and dusted (for, remember, plates can never be properly cleaned out of doors in the sun)—that every article needed for the day has been called over and stowed away—that the stops for the lenses are in the pocket,—in fact, that no spiteful little article, such as a screw for instance, has been permitted to hide away, as it invariably will, if permitted the chance, for the whole family of them delight in upsetting the arrangements for an entire day,—having satisfied himself on all these important points, the pupil may now venture out. We shall have no occasion to tell him how to perform all the ordinary operations in photography, for he already knows them, but we will point out to him all those matters that claim his earnest attention. As the grandest cloud effects are to be met with when the weather is most uncertain and stormy, the pupil should always choose a sheltered spot for his tent or dark box, and place it out of the sun when possible. A damp sponge should always be carried to sponge the inside of the tent or dark box, and also the camera; for remember, dust is the great enemy of the out-door photographer, and delights in marring his best productions. It will be best to pack the plates together in paper with nothing between them, for the box will be needed for the wet plates, and besides, it is better to keep the clean surface from the atmosphere, especially when working at the sea-side, for when the wind is high the air is loaded with sea salt, and great difficulty will be experienced, even with the greatest care, to keep it from the clean plates. Take care to be provided with a piece of yellow calico, for few of the yellow glass windows are really non-actinic, and remember, it is a

great test for any yellow glass to work with every thing in the most sensitive condition, and with the plate within an inch of the window. There are more failures in out-door pictures from the insufficiency of the yellow glass than from any other cause.

In coating the plate, remember that the temperature is generally higher than in the dark room at home; therefore, though every thing should be done without haste, the plate must not be allowed to get too dry. The moment the thick edge has set, the plate should be immersed in the bath with one steady movement. In putting the plate into the slide take care to have the thick edge at the top. Attention to this is important, for, without this precaution, frequently the solution will run in streaks, which will show after development.

Take care, in developing, to have sufficient solution in the glass measure, and to carry it all over the plate at one sweep. Nothing but practice can give the skill needful to produce perfectly clean pictures out of doors; therefore words are here altogether useless. Any one working at home knows the difficulty experienced in getting a perfectly uniform background to a portrait. In instantaneous pictures this difficulty is wonderfully increased, for all the circumstances are against the operation, whilst the importance of perfect manipulation is increased, for in these pictures the sky is rendered, not by a patch of white, but by delicate gradations. This point must, therefore, not be lost sight of in intensifying. Be careful, therefore, to get out as much as possible, applying, when needful, the developer two or three times, and when nothing more can be brought out then well wash and apply the intensifying solution, with a small quantity of silver added, and remember, that as in instantaneous pictures hardness is the prevailing fault, care must be taken not to intensify too rapidly: do not, therefore, be lavish of silver, especially at the commencement of the second operation. After fixing, great care in washing is needed, for if the negative is imperfectly washed, and any check occur in drying, a mark is left which will spoil the picture.

In making the exposure, no great difficulty will be experienced when working for ordinary cloud effects. A dexterous uncovering and covering of the lens with the focussing cloth will suffice. But in attempting to secure breakers on a squally day, great skill is necessary to make the exposure with the dark cloth; an instantaneous shutter is therefore very useful. There are many different kinds, some attached to the lens and some

inside the camera, but the one used by the writer of this chapter is placed inside the camera, and the exposure is made by pressing a rod that comes through the top of the camera. This shutter has a great advantage over others, for it is governed by the operator, and can be made to travel slow or quick at will.

Having now, as far as the limits of this chapter will permit, described the means to be employed to ensure success in the manipulatory part, we cannot finally leave our pupil without a few concluding words of advice. Remember that the most perfect manipulation is utterly useless, unless besides there is taste. How frequently an indifferent photograph, but possessing pictorial qualities, is admired by all who see it; whilst another, perhaps faultless as a photograph, is completely offensive to the eye of the man of taste, because it is utterly destitute of all those qualities which go to the making of a good picture. Hitherto, so much attention has been devoted to the chemical part of photography, that no time has been left for that artistic cultivation of the eye so imperative to the painter, and therefore equally necessary to the photographer who desires to rank as an artist also. The pupil will, therefore, do well to read all the works on art within his reach. He will soon be amply repaid; for reward will be in proportion to the exertion. His vision will be wonderfully extended. Objects before so common as to be invisible to the mind's eye will stand out with a new distinctness. He will be surprised to find how few materials are needed to make a picture—that whilst others travel hundreds of miles to photograph some distant scene, and return with results worthless as pictures, he can, in a journey of a few miles, pick up charming bits which at once arrest the attention of all who see them, and he will be amused at the eager inquiries of the less observant, who will want to know where such spots are to be found: he will, in fact, find that the *picture* is truly in the eye of the artist, be he painter or photographer; for without the power to see the beautiful in combinations of light and shade, and outline, all his labours will be worthless. The pupil would do well, therefore, in purchasing every now and then some of the photographs of our best artists,—Wilson, Bedford, and others,—when he will find almost as strong an individuality in their productions as is to be found in the works of the best painters. He will also have a standard of excellence before him, which will inevitably act as a spur to urge him on from good to

better. Finally, let him remember that besides all the art-education necessary to produce really good works, nothing great will be done without painful, plodding perseverance, and an inexhaustible stock of patience. Failure must ever act as the whetstone on which to sharpen up his flagging zeal, and if he work in the right spirit it will be worth more to him than his greatest successes.

Landscape Photography.

This will necessarily be a short chapter, for nearly all written in the preceding one on Instantaneous Photography applies in the practice of ordinary out-door photography; the points of difference being principally in the kinds of lenses employed, the stop used in the lens, and the developing solutions. We would here say to the pupil that even in large pictures, where the exposure must necessarily be several seconds, it will always be better to get into the picture as much atmosphere as possible, and in order to do so work with the largest stop that can be used to give sharpness in the picture sufficient to satisfy the eye. It has been one of the greatest mistakes of past times to exalt sharpness over every other quality: thus we see in old productions the distance so immensely hard and sharp,—so much, indeed, like the canvas and cut-out wood productions of the theatre, that one could almost realise the possibility of tumbling over on the other side. The great difficulty in out-door operations, when the exposure exceeds a second, is to secure a day sufficiently calm, and many vexing disappointments will come in consequence; for trees like children ignore the requirements of photography, and will insist upon nodding their heads and throwing their arms about in a thoroughly irritating manner. We hope the time is not far distant when we shall be able to get landscapes on 12 by 10 plates, and even larger, with an exposure of less than a second, but to do this we fear our friends the opticians must help us, by giving us lenses to admit more light, and yet give us the requisite amount of sharpness; for whilst we admit the possibility of bringing out by lengthened development an image when the exposure has been much shorter then usual, yet the quality of the finished picture is rarely good.

We would advise the bath to be weaker than the one employed for instantaneous operations. Thirty grains of silver to the ounce of water will be quite strong enough. Follow out the method of preparation described in the preceding chapter. The developer also must be weaker, and the best results will be produced with a developing solution of—

Ammonia-sulphate of iron	10 grains.
Acetic acid (glacial)	15 drops.
Water	1 ounce.
Alcohol (when wanted)	

This developer will be found to act much slower than the one recommended for instantaneous operations, and will therefore be easier to use when working large plates. Care must be taken not to hurry the development, for details will continue to come out for a lengthened period, and it is better to get out all you can if the exposure has been rightly timed, for there will be less to do in the after intensification of the negative.

All the precautions for the avoidance of dust must be taken; and as in a tent, where it is necessary to get inside when working for large pictures, it is more difficult to keep free from it, greater care even is needed.

Be careful, in exposure, to give plenty of time, for, of two faults, over-exposure is much better than under-exposure; for by quickly stopping the development in a case of over-exposure when the picture flashes out on the first application of the developer, and after well washing, by adding more than the usual quantity of silver to the intensifying solution, the picture may be saved, and may be made quite a respectable one; whereas no amount of development will prevent a picture which is really under-exposed from being heavy and sombre in the shadows.

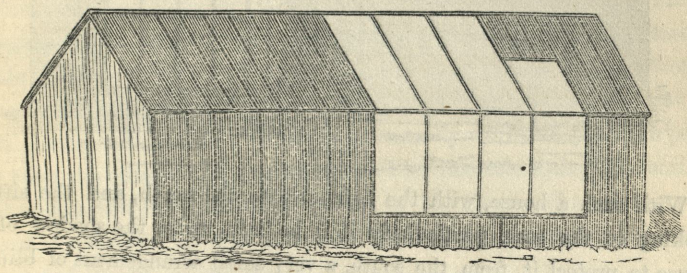
We have indicated all the points of difference in working for large as compared with small pictures; and in order to ensure success, all the cautions and hints of the preceding chapter must be carefully attended to.

On Lighting the Sitter.

On this most important matter more ignorance has been exhibited than in any other department of photography. Hitherto it has been considered sufficient to build a studio with plenty of glass in it; and with a large proportion of photographers the first question was—not, *how do you get harmonious pictures, or how do you manage best to get softness into your shadows, and avoid patchiness in your high lights*—but "*what exposure do you give?* I can get pictures in two seconds." That they could get photographs was probable, but as to the pictures? well, there is room for grave doubt. The only difficulty with the class we refer to was how to keep the sun out of the lens. Its rays might stream on to the floor *within* the room, to be reflected into the eyes of the sitter without hindrance, so that it could be kept out of the lens. The rage for carte pictures has done much to purify photography, for with it has come a demand for untouched pictures, and hence the necessity for more perfect results. In what we may now call the old-fashioned days of photography, so much was left to the artist who had to adorn the picture with all the treasures of his pallet, that the photographer grew indifferent. It was a matter of no importance to him if the eyes came out fishy and flat, or like heavy caverns relieved by no light; the magic of the artist's pencil made up for all short-comings. The reform has not come a moment too soon, and with the acquirement of more art knowledge by the men now called operators, but in the good time to come, to be known as artists, photography will take the position among the fine arts which it will then have won; and all honour to such men as Robinson and Rejlander, who, without thought of gain, go out of the profitable track to show what may be accomplished; who, in fact, hold up the light to show the way to the timid followers.

All those rules so imperatively insisted upon in teaching the embryo artist are equally important to the young photographer. A sculptor would be much puzzled to produce a great work in many photographic studios, where the light comes blazing in all round. Before he did anything he would shut out three quarters of the light, and modify the remainder. Now the sculptor's light is not quite the light required by the

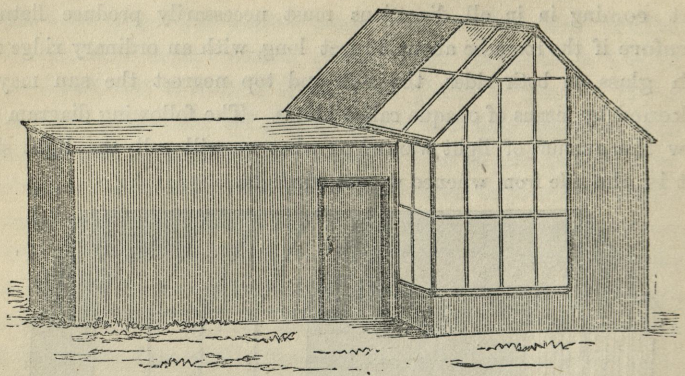
photographer, for in consequence of the transparency of the shadows in marble he can do with more top light; but the same general principle of arranging is needed. In order to produce the best effect the light wants bringing on to the sitter in a pure mass, and in one direction, for light coming in in all directions must necessarily produce flatness: therefore if the room be about 30 feet long, with an ordinary ridge roof with glass on both sides, the side and top nearest the sun may be darkened by means of opaque calico blinds. The following diagram will show the amount of light wanted on what we will call the light side; that is, the side from whence we get our light.



It will be seen from the above diagram that in a place 30 feet long, 15 feet, or half, would be darkened altogether, also 5 feet at the end, where the sitter is placed; so that altogether not more than 10 feet of side and top light would be needed to produce the best results. These remarks are made to apply to places already in existence, for we would not advise the amateur to build such a place but he will see the manner in which the light is required to fall on the sitter to produce roundness. Many advocate the letting in of a little light on the shadow side, but we are not of the number, for as the shadow side is generally the side placed to the sun, any light admitted, unless very much subdued, would be too strong. The above diagram will show that the greatest mass of light will fall on the sitter at an angle of 45°, if the camera be placed in the middle of the room. No matter on what plan the studio be built, sunlight should be excluded for all ordinary subjects; indeed, unless specially wanted on the sitter, small patches of sunlight, no matter where they fall in the room, always, by their strong reflections, destroy the harmony of the picture.

The cheapest and best kind of glass house for the amateur is one described some years ago by Mr. Sutton, and modified in various ways since. The main feature is the making of a light room sufficiently large

for the sitter, and then adding a long dark passage for the camera ; * by such a plan not nearly so much material is needed, and yet all the advantages of a long range are secured. The simplest and easiest house to build on this plan would be something like the following :



With such a house, with the light side to the north, and the sitter looking to the east, particularly if it be built under the shadow of a house to protect it from the south, a very small arrangement of blinds would suffice, and the light would be uniform throughout the day. Only those who have had the trouble and difficulty of shutting out the sun know the comfort to be derived from a glass house well screened from the sun. In such a place failure is reduced to a minimum, for one of the greatest causes is removed, viz., the great variation of light, and consequent difficulty to determine the right exposure. We have said enough to show the kind of light needed, and the importance of having the camera in the shade. The ingenious amateur will be enabled to modify the design to suit his means, and those who do not desire a glass house can, with a canopy over the sitter and shade on one side, manage to get very good results if he carefully store up the cautions we have given. Should he have too much shadow on one side, by the judicious use of a white screen he can throw as much light as he may desire into the shadow side. Indeed, if he bear in mind the necessity of having the light on the sitter at the angle we have mentioned, and keep the camera in the shade, and above all, avoid direct front light on the sitter, he will not fail to get good results.

* See sketch of Glass Room at beginning of Manual.

Carbon Printing.

THE chief objection to silver prints is the liability to fading. In consequence of this, experiments have been carried on for a number of years to obtain prints in some unchangeable pigment—such as carbon, with more or less success, by several ingenious photographers. Thus we have the carbon process of Pouncey, of Poitevin, of Salmon and Garnier, of Placet, Fargier, Swan, and others. Mr. Swan's process is that most recently made public, and although embodying the chief points of several other processes, it has original merits which, though apparently slight at the first glance, will probably render it more easily workable and more popular than the others. It is as follows :—The film containing the sensitive salt and carbon is denominated a *tissue* by Mr. Swan. The tissue is composed of collodion on one side and bichromated gelatine, mixed with sugar and carbon, on the other.

The mixture of gelatine used consists of one part of a solution of bichromate of ammonia (containing 1 part of the salt in 3 parts of water), 2 parts gelatine, 1 part sugar, and 8 parts of water, with colouring matter added to produce the depth of tint required: the pigment used being indian ink, either alone or mixed with indigo and carmine.

The tissue is *formed* by coating a plate of glass or other smooth surface, first with collodion, and then with the coloured gelatine mixture above described: a plain collodion, giving a stout tough film, must be used: collodion giving a rotten tender film is of no use ; the two films unite, and, when dry, may be separated in a sheet from the surface they were formed on by cutting round the edges with a knife.

By this means a pliant tissue is obtained which may be handled like paper, and may either be kept in large sheets, or cut up into pieces of any convenient size ready for printing.

The tissue prepared in the manner described corresponds with sensitive paper ; and, with proper appliances, the preparation of it need not be more troublesome than the double operation of albumenizing and exciting paper in the usual way.

The tissue is much more sensitive to light than ordinary sensitive

paper, and proportionately more care must be exercised to guard it from the action of light, other than that which acts upon it while in the printing frame. Like sensitive paper, too, it is better used soon after its preparation.

The printing is done in the usual way, the tissue taking the place of sensitive paper, the collodionized surface being placed next the negative. The sensitiveness of the tissue may, of course, be varied by varying the proportion of the components of the gelatinous part of the tissue; but with the mixture here given, the time of exposure required is only one-fourth, or less, of that which would be usually given with highly sensitive albumenized paper.

The proper time of exposure can be determined pretty accurately after a few trials, for although there is not the same means of judging of the progress of the printing as in the ordinary process, yet there is a far *wider range* between *under* and *over exposure* than in silver printing. It is no exaggeration to say that you may expose one piece of tissue twice as much as another, and yet obtain a good print from both; not perhaps *quite* so good as between the two extremes, but yet much more passable than would be the case with silver prints under and over exposed to the same extent.

There is one means, however, by which *any mistake* in *timing the exposure may be altogether avoided*, and this is by the use of a PHOTOMETER. You have this in a simple form by attaching a *very small piece* of sensitized paper to each frame exposed—or if a batch of frames be exposed at the same time, one piece of paper will do for the lot. A little practice will enable the operator to judge by the darkening of the paper whether the gelatine film has been exposed long enough. With a proper classification of negatives, say into three classes, the weak negatives forming one class, the dense another, and the medium another, all of one class being exposed simultaneously; and with this photometer to determine exactly the amount of exposure which produces the best result, the operation of photographic printing on an extensive scale may be made as certain and uniform as common printing is.

On taking the tissue from the printing-frame, the image is faintly visible, and the next step in the process is to mount the tissue, with the collodionized face down, upon a piece of paper, or any other suitable material, to act as a support during development, and sometimes to form

the basis of the picture, which may, if we please, remain permanently attached to this support, or may, if thought better, be afterwards transferred in a manner which I will presently explain.

There are several ways of mounting the tissue, and several adhesive substances may be used for the purpose. I have used starch and also a solution of indian rubber and dammar in benzole.

After mounting, the tissue, with paper attached, is placed in water of about 100 degs. Fahr. The water presently begins to dissolve away the non-solarized portions of the gelatine, and in a few minutes the picture is fully disclosed. It is, however, advisable not to hurry the operation, but to give the water ample time to dissolve out the bichromate. It is also advisable to change the water three or four times. I prefer to leave the prints about two hours in the water. Where the picture has been over exposed, longer immersion and hotter water will, in a great degree, rectify the mistake. Before finally removing the prints from the water, I brush the surface lightly with a broad camel-hair brush; and after taking them out, I pour a stream of water over them, to remove any loosely adherent particles of foreign matter that may, by accident, have got attached to the surface.

The prints may then be hung up to dry, and are finished by being mounted on cardboard and rolled in the usual manner.

Another way of proceeding is to *remount* the developed print, *face downward*, upon a second piece of paper or card, say with starch or gelatine, and, when this is dry, to remove the paper that was attached to the tissue previous to development; this can easily be done, if the surface of the paper is moistened with benzole.

In one way the image is *reversed*, and the collodion surface is *downward*; and in the other the image is *not reversed*, and the collodion film is *uppermost*.

In practice, I think the transfer process will not be found difficult; yet, probably the simpler mode will generally be preferred, and the objection of the reversal of the image be met, either by taking the negative *through the glass*, or by transferring the negative by means of gelatine.

Photography with Dry Plates.

THE cumbersome apparatus necessary when using the wet process for field operations, as well as difficulties connected with the working of same away from home, has given rise to the use of dry plates as a means of freeing the photographer from a tiresome burden, as well as from a variety of mechanical operations the performance of which most amateurs are averse to; for, if the student so desire, he may obtain the dry plates prepared ready for exposure in the camera, and need not trouble himself with the coating, sensitizing, &c. It is not our intention to lay before the student an account of *all* the dry processes that have been *invented*, or to confuse him by an elaborate treatise on the *theory* of the dry collodion processes, but to give him such information as will be of service in enabling him to carry out his operations as an out-door photographer, with as little discomfort as possible, and a good chance of success. As the limits of our chapter are prescribed, we shall confine ourselves to treating of two processes which have, in the hands of many photographers, given results equal in rapidity to wet plates. To ensure his ease, the student has merely to master one of these, and the first given has our preference. As the developing and fixing may be done at home after the completion of the day's work, the operator will only need a light tripod stand, a small portable camera, and a small bag for carrying the sensitized plates, carriers, &c., necessary for taking a couple of dozen pictures. We will give, in the first place, Major Russell's

TANNIN PROCESS.

The plates for this process, previous to coating with collodion, may be prepared in various ways in order to secure the film from wrinkling or washing off during development, &c. For small plates, roughing the surface of the plate with emery paper about an eighth of an inch from the edge all round will be sufficient; for large plates, a solution of india rubber in kerosolene may be used, as recommended by Mr. Sutton and others, or the plate may be coated, in the first instance, with a solution of gelatine, as recommended by Major Russell. The plates should be cleaned with great care, for the least dirt will spoil a plate.

To prepare a solution of gelatine proceed as follows :—

Formula.

Gelatine	60 grains.
Glacial acetic acid	12 minims.
Distilled water	20 ounces.

Immerse the gelatine in the water, and let it remain for two or three hours in a warm room to soak and soften, after which add the acetic acid, and apply a gentle heat until the gelatine is dissolved. Add one ounce of alcohol to each ounce of solution, and filter two or three times through paper before using. The glass plate, which has of course been properly cleaned, is warmed and coated with gelatine solution in the same way as with collodion; this should be dried before a clear fire. Spontaneous drying in a warm room has been recommended by some photographers in preference to drying rapidly by artificial heat. Plates so prepared may be stowed away and kept an indefinite

length of time in grooved boxes, or they may be at once coated with collodion. A good bromo-iodized collodion must be used for this purpose, and the film must be allowed to set a little longer than in the wet process. When the film is properly set, the plate is immersed in an ordinary negative bath, rendered slightly acid with acetic acid: about one drop of ordinary acetic acid to two ounces of neutral bath solution will do.

When the colour of the collodion film indicates its complete sensitization, which will be produced in about four or five minutes under ordinary circumstances, the plate is taken out and immersed in a dish of distilled water, moved about for a short time, and then left, collodion film upward, until a second plate is prepared ready for washing. It is then taken out of the dish, washed thoroughly under the tap with common water, and finally flowed with distilled water.

It is next coated with the preservative solution of tannin (the strength of which may vary according to the nature of the collodion, &c., from 10 to 30 grains to the ounce,) which is prepared as follows:—

Tannin	15 grains.
Distilled water	1 ounce.

Dissolve, and filter through paper before use, and then add four or five minims of alcohol to the ounce of water, but always after filtration. Of this solution pour first a small quantity upon the plate, so as to remove before it all superfluous water; pour it on and off two or three times, and afterwards cover the plate with fresh solution. Allow the plate to drain for a minute or two, then rear it upon end upon a piece of blotting paper, and afterwards dry spontaneously or by artificial heat, remote from all light. When perfectly dry the plates will keep in the dark for a long time. The student should bear in mind when preparing tannin plates that the greater the quantity of tannin used the greater will be the density of the shades. He should, therefore, endeavour to prepare his plates according to the character of the work he requires them for. When the contrasts of the landscape are very marked and the light brilliant, a less quantity of tannin may be used. When the plates are dry, the film, if in right condition, will be bright and highly polished in its appearance.

It will be found advisable to use the plates as soon after preparation as possible, as they lose in sensitiveness and deteriorate by long keeping.

The time of exposure is about as long as with the wet process when the following development is used.

Development.

No. 1	Pyrogallic acid	144 grains.
	Alcohol	2 fluid ounces.

Filter if there be any turbidity, but not otherwise.

No. 2	Nitrate of silver	40 grains.
	Citric acid	40 grains.
	Distilled water	2 ounces.

Filter if there be a white precipitate, otherwise not. With No. 1 and 2 as stock bottles, proceed as follows:—

Mix for present use

Solution No. 1	1 drachm.
Distilled water	6 ounces.

Of this dilute solution of No. 1, take out four drachms for a stereoscopic slide or plate of similar size, and add to it from 15 to 25 minims of No. 2. This mixture is made immediately before the plate is to be developed.

Supposing the plate to have received the requisite amount of exposure, at a convenient time when you have arrived at home, proceed as follows:—

Immerse the dry plate for a few seconds in *hot* distilled water, then pour on the developer, prepared as above, and keep it in motion until the image appears. If the picture is slow in making its appearance, although the sky develop quickly, the exposure given was too short, and the developer must be increased in strength, by adding 10 or 15 drops of No. 1. On the contrary where the time has been too long, the development on all parts will be simultaneous, and the proper equilibrium of action will have to be maintained by adding a few drops of No. 2, otherwise the sky will not be sufficiently opaque.

The developed plates are well washed, and fixed in a bath of hyposulphite of soda—cyanide of potassium is not recommended as it is apt to loosen the film. They must then be thoroughly washed, great care being used not to disturb the film.

In order to secure pictures on tannin plates with a short exposure, same as with a good wet collodion plate, the following mode of development is recommended:—

Make a saturated solution of bicarbonate of soda in cold water, and filter it. Make also an alcoholic solution of pyrogallic acid, 10 grains to the ounce of alcohol, and filter it also. Then develop the plate in the following manner: first, immerse it in warm water for a few seconds; then mix in a measure 1 drachm of the soda solution and 1 ounce of water, and pour this all over the plate. The probability is that it will produce no visible effect, but that will depend upon the character of the plate, its mode of preparation, and the nature of the light during exposure. When the soda solution has remained a few seconds on the plate, return it to the measure, add to it a few drops of the alcoholic solution of pyrogallic acid, and pour the mixture again over the film. The picture will now become visible, although not of much strength. Let the solution remain a minute or so upon the plate until it has developed all the details of the picture; then wash it off, and intensify in the following manner: first, pour over the film the usual pyrogallic acid developer, containing acetic acid but no silver. This does not act as an intensifier, but it neutralises the alkalinity of the film, and prevents fog in the next operation. Now pour this back into the measure, add to it a few drops of a 20-grain solution of nitrate of silver, and pour it again over the film. This solution must be poured on and off the plate in the usual way until the negative has acquired sufficient strength. When this point is attained, pour off the intensifying solution, well wash, and fix with hyposulphite of soda. After washing off the soda, dry and varnish in the usual way.

Dr. Hill Norris's Gelatine Process.

In this process, gelatine is used as a preservative. Coat the plates with a non-contractile bromo-iodized collodion, and after the film has been sensitized in the ordinary nitrate of silver bath prepared for negatives, and allowed to drain, pour upon it a solution of honey, containing one ounce of honey to two ounces of distilled water. This solution must be warmed and filtered through filtering paper previous to its application. It may be preserved in vials *completely filled*, for a considerable time. After the plate has been thoroughly covered with the syrup, it is carefully washed beneath the tap, until the washings no longer taste of honey or silver. The plate is next flowed with the following solution:

PRESERVATIVE SOLUTION.

Gelatine	1 drachm.
Distilled water	20 ounces.
Alcohol	4 drachms.

Soak the gelatine in water until it has swelled, then apply heat to dissolve it. After it has become cool, mix with the solution the white of an egg very intimately, then boil the mixture so as to coagulate the albumen. Let it stand for a few moments, and then filter whilst still hot through a flannel bag before a fire. The first portion of the liquid passing through this filter will not be clear, and must be returned to the funnel and again filtered. The alcohol is next added to the clear solution, in order to communicate to it keeping properties. The solution must be made warm before being applied to the plate, in order to render it perfectly liquid. This can be done by immersing the vessel containing it in hot water. The plate about to be coated should also be warmed. The gelatinous solution is poured on the plate in the same way as collodion; the solution is allowed to remain on the plate for a moment; fresh solution is then poured upon the plate and off again until the film is quite uniform. Drain the plate, and dry in a warm place or by artificial heat.

After exposure, the plates are immersed in warm distilled water until the film has become thoroughly moistened, they are then taken out and covered with the following developer:—

Pyrogallic acid	3 grains.
Citric acid	1 grain.
Distilled water	2 ounces.

Add to each ounce of the above solution half a drachm of a solution of nitrate of silver, containing 15 grains to the ounce of water. Wash thoroughly when the image is fully brought out, and fix in hyposulphite of soda. Wash, dry, and varnish the negatives thus obtained.

On Enlarging.

BY MR. W. H. WARNER, OF ROSS, HEREFORD.

In treating of this subject, before entering into any manipulative details, it will be but right to give some account of the early experiments made in this process. Solomon tells us that "there is nothing new under the sun," and, certainly enlarging, whether by the solar camera or by way of transparency, is *not* a "new thing." The magic lantern of our school-boy days furnishes an explanation of the former in a rough way, while the well-known fact of the nearer you approach to an object the larger it becomes, and *vice versâ*, will be an illustration of the latter.

That the latter was first to appear on the photographic stage there can be little doubt, and many years ago it was practised in an imperfect way and finally abandoned. Still the idea remained, and nothing was thought of it, comparatively speaking, until the year 1862, when Mr. Vernon

Heath, Mr. Fry, and myself simultaneously brought our efforts before the public. That it was at once appreciated an important advance in the art had been made, is shown by the great interest that was taken in it by the profession and amateurs generally. Other gentlemen then took it up, and it has now reached a perfection rendering it difficult in many cases to distinguish between the picture taken direct and the one enlarged.

The process intended to be specially described in this paper is that of making enlarged negatives.

It is a fact too often forgotten, that when negatives are sent for enlargement, the more the particles of matter forming the image are expanded or drawn out, the coarser and rougher they become, and unless the negative so sent be extremely perfect, the results obtained will be anything but satisfactory. It is far better to have a picture a moderate size *good* than to have a very large one *bad*, requiring an amount of touching to render it anything like passable. Constantly negatives are sent to me of such a character as to rack one's ingenuity how to produce decent results, and sometimes I am led to imagine that the parties sending these negatives do so under the delusion that in making the new negative all their faults can be done away with, and are surprised, and often angry, when they find to the contrary. The negative best fitted for this kind of enlargement is one developed with iron of a drab colour, by reflected light, and presenting by transmitted light a picture perfect in gradation of tone, and which in ordinary printing gives the most satisfactory results: it must *not be too thin*, neither must it be *too dense*. A negative giving a black and white positive, no matter how much detail it may possess, is *not* fitted for enlargement, because all its faults will appear worse when exaggerated, and the larger it is made the worse it becomes. The same remarks will apply to a hard negative, also to an under-exposed one, although the same may be somewhat remedied in the development of the new negative.

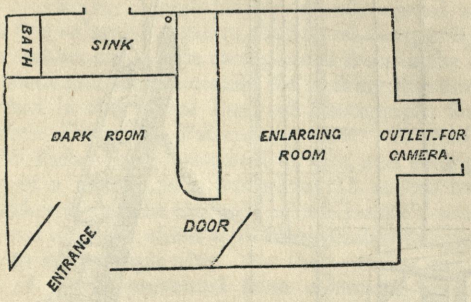
The size of the image on the plate is a matter of importance. Thus, to produce a life-sized bust, the head ought not to be less than $1\frac{1}{4}$ inches in length, and full of detail. The size of the glass may be half-plate, third size or quarter-plate. A three-quarter length is best made from a third size plate (5×4), while a full length is better from a quarter-plate. As a rule, I do not advise negatives to be made larger than 20×16 or 15×12, as up to those sizes perfectly clean negatives may be worked, full of half-tone, without resorting to developing stands, &c., which, in my opinion, are at all times incumbrances best avoided.

It is necessary, where the process is followed commercially, to have a room specially set apart for this work. Some photographers have, I believe, the lens fixed in the roof, with a projection for the negative; and for the purposes of focussing, a table or disc is arranged to move up and down by means of rack work; lastly, in order to get the most perfect exactitude, a very fine screw adjustment is attached to the lens. One photographer uses a wooden camera, with an arrangement so fixed that by a previous knowledge of the exact focal length of the lens, the trouble of focussing is entirely done away with. This camera is very expensive.

The following is the arrangement used by myself:—Two rooms have

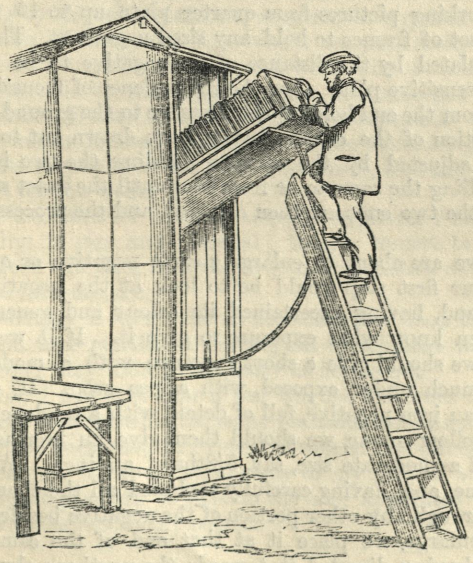
been built, the floors of which are raised three feet from the surface of the ground. One is arranged as an operating room, fitted with sink, shelves, &c.; the other for working the camera, which always points to the northern sky. Fig. 1 is a plan of the same.

Fig. 1.



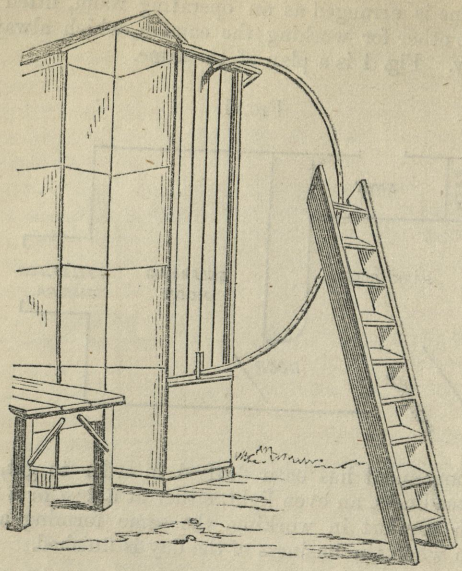
A novel arrangement has been devised in order to get, at the same time, perfect steadiness, an even light, either at a low or a high altitude, combined with comfort in working, the same forming a door to the enlarging room when the business of the day is finished.

Fig. 2. The above arrangement when working.



The operator arranging the subject for enlargement.

Fig. 3. The enlarging room closed.



The camera, which is nine feet in length, with a cloth body, is arranged for working pictures from quarter plate up to 15 × 12. It is fitted with a set of frames to hold any sized negatives. The size of the image is regulated by the distance of the negative to be enlarged, the lens, and the sensitive plate For the convenience of focussing, two iron rods extend from the end holding the negative to the ground-glass screen; the lower portion of the camera having been drawn out to get the size, the focus is adjusted by the operator holding the two iron rods and pushing or pulling the same to or from him until the exact size and focus be obtained; the two ends are then clamped, and the process proceeds as follows :—

Supposing we are about to enlarge a carte negative or quarter plate to 15 × 12, our first step would be to look at the negative by transmitted light, and, having ascertained its colour and general qualities, we should then know what exposure to give it. If it were of a blue or grey tinge we should give a short exposure with a moderately small stop; if *very* much under exposed, with a pea stop. If, on the contrary, it were an iron negative, full of detail, with a tendency to a brown or greenish yellow colour, we should then give an increased exposure with a stop of a moderate size, say, 5/8ths of an inch. We now place this in a frame, and, having carefully excluded all the chances of light penetrating through any other portion of the negative besides that which we wish to enlarge, we place it at that end of the camera which is shortest, and, having directed it towards the northern sky, we proceed to focus, at the same time enlarging it, say, to whole plate. This done, we take a collodion picture in the ordinary way, as detailed in the former

part of this work. This will be a transparent positive. If the exposure has been correct it will be *very* beautiful, and I have often thought that if these positives could receive a glaze of transparent colours in oil they would form a great attraction and novelty to our English ladies. The positive being dry, we next proceed to place it in a similar frame to that used before, being careful to exclude all the light, and then we enlarge it up to the size we require it. A plate being prepared, exposed, and developed, the result is a fine enlarged negative, having all the quality and characteristics of the smaller one. It is then printed from in the ordinary way

A very excellent and simple camera for making this kind of enlargement is described in the "Year Book of Photography for 1864," published by Thomas Piper, 32, Paternoster Row. It consists of a base board about 36 inches long; attached to this, and sliding in a groove like the body of a camera, is a box about 12 inches long, 10 inches wide, and 3 inches deep (like the body of a Kinnear's camera). Into a groove at one end a holder slides with inner frames to receive negatives, from 10 by 8 to stereoscopic size. To the opposite end is attached a flexible body of cloth, prevented from collapsing by elastic bands. When it is required for use we place a camera on the other end of the base board, and attach to the lens the flexible body of the box just described. A negative is then placed on the frame in the box, and the whole is so placed that the light from the northern sky passes through the negative, and to the lens in the camera attached, and so forms an image on the ground glass. The lens best suited for the work is that which will give the flattest field.

In enlarging by the solar camera a negative is required *thin* but full of detail, because, if dense, the light would not pass easily through the film, and the result would be a black and white picture without any half tone. The apparatus by which pictures are thus enlarged has been so often described that I trust it need not be here repeated. The enlargement by this means is made direct on to the sensitizing paper,* and very fine results may be obtained; but it requires, like the other, a room to be set apart for the work.

The cost of a camera for making *enlarged negatives* I find varies very much, according to size and material; thus, a camera to enlarge from stereo. to 10 × 8 will cost, in mahogany, lens included, about £12, with all the necessary frames, &c.

The manipulation is the same as that described in a former part of this work; and any gentleman having an attachment for any special kind of developer may indulge his fancy as he pleases.

In conclusion, I feel sure that if our English amateurs could only see the extreme simplicity by which so many beautiful results may be obtained, they would not be backward in experimenting in this direction. Should any of them happen to wend their steps to my part of the country, it will give me great pleasure to explain my own apparatus to them, and to aid them as far as lies in my power.

* See printing by developments.

Enlargement by Solar Camera.

This mode of enlargement is preferred by some operators, and gives very fine results. The solar camera, which is the name given to the instrument used, is the invention of a gentleman of the name of Woodward, but since first introduced to photographers it has been improved by Mr. Atkinson, of Liverpool, in various ways. Enlarged pictures, obtained by the use of this apparatus, are taken direct on the sensitized paper, and, as noticed in the preceding chapter, the negative from which it is intended to obtain such enlarged pictures must be thin, but full of detail. The presence of the sun is desirable for this mode of enlargement; but very good pictures can be obtained with a good diffused light; and the paper used may be the ordinary albumenized paper, or plain salted paper, as described in our chapter on printing by development. With the latter the exposure is so much shorter that it is generally adopted. The paper required for this kind of enlargement may be obtained ready for sensitizing in the silver bath by those who do not care about preparing it themselves. A suitable room having been constructed, with a window having a southern aspect, the photographer may proceed to work. The camera is properly fixed in the window, and the light used must come only from the mirror to the condenser. The negative to be enlarged is placed in its proper position, and all light must be excluded from the room except that which proceeds through the camera. The mirror is placed at a proper angle by means of its adjusting screws for throwing the light into the condenser, and the luminous image so formed is accurately focussed on the screen to which you intend to attach the sensitized paper, or in place of which you intend to insert the frame carrying the paper. Having done this, shut out the light and attach your sensitized paper to the screen, and afterwards let in the light. It is necessary that the paper should lie perfectly flat, and in order that this may be so it is best to make use of a frame to replace the screen, and proceed as follows:—Rub the back of the paper with a wet sponge, and after it has thoroughly expanded, and lies uniformly and without undulations, go round the edge to the depth of half an inch on the same surface which has been sponged with a thick solution of gum arabic; attach the paper to the thin wooden frame, which must be of somewhat smaller dimensions than the paper, and allow to dry. When dry, all wrinkles and creases will have disappeared. There is a window to admit yellow light into the room, in order that the operator may see how to work.

All the details of the printing are given in the chapter on printing by development, to which we refer the student. Solar camera printing on albumenized paper is a very tedious process; but if the student wishes to try it he has merely to expose the paper on the screen until the image is printed a sufficient depth, and wash, tone and fix it the same as in ordinary printing.

Defects and Failures, and their Remedies.

It cannot be expected by any one studying an art beset with so many difficulties as photography undoubtedly is, that success will invariably attend his efforts, howsoever well directed they may be. Defects will most likely become apparent in his productions at every step he takes, resulting sometimes from

want of skill on his part, either in the manipulations, or in the making of the bath and developing solutions, or from imperfections in the apparatus used and impurities in the chemicals and collodion employed. Some of the causes of failure have already been slightly dealt with in the preceding chapters of this treatise, but we shall now proceed to treat in detail and more fully all the most prominent defects the student will meet with in making collodion negatives and positives, and positive prints on paper.

Defects in Collodion Negatives and Positives.

Fogginess.—This is a mist or veil-like appearance that covers the whole negative or positive, and gives it a foggy or clouded appearance. This imperfection may be the result of many and various causes, as, for instance: diffused light in the camera through holes or chinks; reflections from white or unblackened surfaces in the camera; diffused light through apertures or chinks in the door behind the plate in the plate holder; direct rays of the sun through the objective or lens; an alkaline, neutral, impoverished, or contaminated state of the nitrate of silver bath; a similar condition of the collodion; certain iodizers in the collodion, and at certain stages of ripening; diffused light in the dark-room; too intense a developer; fumes of ammonia, of turpentine, of tobacco, of hydrosulphuric acid, and probably almost of any other volatile chemical substance in the developing-room; imperfect cleanness of the glass plate that has been used before; the use of gutta-percha baths and dippers.

Diffused light in the camera, either in front of the plate or behind it; reflections from white or unblackened surfaces in the camera.—This is a certain cause of fogging, and can easily be remedied. Examine the camera carefully for all chinks and holes. Some photographers are very careless; they screw the flanges of various-sized lenses on the end of the camera, and neglect filling the apertures left by the screws when withdrawn. Chinks occur invariably in cameras made of green wood; and the bellows part, by frequent adjustment, sometimes cracks. The plate-holder has also its imperfections; the slide sometimes allows the entrance of light. The door behind may close inaccurately; and the plate-holder may slide irregularly and not fill the groove calculated to receive it. All these are errors or defects of workmanship, which must and can be avoided or remedied. Look, therefore, to your camera first in the search of chinks, cracks, and apertures; secondly, if the inside surfaces of the camera are not of a dead black, cover them with unglazed black woollen or cotton cloth, or wash them over with a thick solution of ink or lampblack.

Direct rays of the sun through the axis of the lens.—Avoid this evil; like many other troubles, to know it, is its total remedy.

An alkaline, neutral, impoverished, or contaminated state of the nitrate of silver bath.—Immerse a piece of reddened litmus paper in the bath, and see whether it changes colour, after a while, to a blue—if so, the bath is alkaline.

First remedy.—Make a mixture of six drops of acetic acid in a drachm of water, if you are taking negatives, and of the same quantity of nitric acid and water, if you are taking positives, add ten drops at a time of either solution until the fogging disappears. Sometimes even more acid may be required.

Second remedy.—Instead of adding acid to the bath, add an old collodion or tincture of iodine to your collodion in present use; this frequently is the safest plan of action.

If the bath is impoverished, it will at the same time be contaminated. The remedy is to boil it some time in a glass flask in order to get rid of the ether, alcohol, and the volatile substances produced by decomposition, as also to coagulate organic matter; then allow the bath to cool, and filter, after which

add more nitrate of silver if required. Placing an old bath in the sun for several days is also of great assistance, but it is far from being equal to boiling.

Certain iodizers in the collodion and at certain stages of ripening.—Iodide of cadmium alone frequently produces fogginess; almost any new and limpid collodion has the same effect. Add iodide of ammonium in the first case, and an old collodion or tincture of iodine in the second case; the sensitiveness will be thereby probably diminished, but the disposition to fog will be removed.

Diffused Light in the Dark-Room, or too intense an artificial light.—Place the artificial light behind a piece of yellow glass, or use a yellow glass chimney. Diffused light must be thoroughly excluded from the room.

Too intense a Developer.—In summer a weaker developer, whether of iron or pyrogallic acid, or a larger proportion of acid is required than in winter, otherwise fogging will be the consequence. The property of acid is to restrain the action of the developer; use your judgment, therefore, and do not always keep to the same amount of protosulphate of iron, or pyrogallic acid to the ounce of water in all seasons; nor restrict yourself unconditionally to the same amount of acetic acid in the developer.

Fumes of Ammonia, etc.—Keep your dark-room solely for its legitimate purposes. Keep it rigidly clean; perform no chemical experiments in it; abjure smoking in this sanctum; do not sensitize your papers with ammonio-nitrate of silver, or fuminate with ammonia in this room.

Imperfect cleanness of the plate, etc.—Wash the old plates with a solution of salts of tartar and water; if this does not remove the adhering dirt, wash it with dilute nitric acid, and afterwards with salts of tartar, and finally clean and polish the plate with rotten-stone and alcohol. Some old plates that have lain long in water in which the old developing solutions have been thrown, I have never succeeded in cleaning so as to prevent fogging; they are contaminated to the backbone, and worthless.

The use of gutta-percha baths, etc.—Instead of these, use glass or porcelain. I prefer glass to every other material.

Spots and Apertures.

Opaque and transparent specks are the most troublesome annoyances in the collodion negative process, and occur to every photographer more or less. These can be attributed to various causes, but seldom for the time being to the right cause; that is, we know in general what will cause them, but seldom what did cause them.

The opaque spots may be caused in the first place by dust on the surface of the glass before the collodion is poured on. The remedy is simple: brush off the dust with a broad flat camel's hair pencil, just before the collodion is applied.

Secondly.—Opaque spots may be caused by dust on the surface of the collodion; this dust may be deposited either from the bath itself, previous to immersion in the bath, or in the camera during exposure. That which is deposited either before or after immersion, are the organic substances in a state of very minute division floating about in the atmosphere, or set in motion within the camera by the agitation produced with the plate-holder. This is, perhaps, the most fruitful source of spots, which are of two kinds, opaque and transparent. The particles of dust attach themselves to the collodion with different degrees of tenacity; where the tenacity is small, the dust is washed off in the different manipulations of developing and fixing, and the consequence is the production of transparent specks; on the contrary, where the tenacity is great, opaque spots are the result; for the particles

remain imbedded after the final washing. If the dust be deposited from the bath itself, it may arise either from organic materials in the atmosphere, or from an excess of iodide of silver in the bath, in the form of the violet-coloured deposit found at the bottom or on the walls of the bath. The remedy is, in the first case, to keep your room-floors moist, and your camera perfectly free from this enemy, by dusting and sponging. In the second place, the insoluble deposit in the bath is separated by filtration; the bath, too, is thoroughly cleaned by a sponge tied to the end of a rod, which can be made to enter into the angular spaces in which the dust is deposited.

Thirdly.—Another source of this trouble with opaque spots is to be found in the collodion, which contains sometimes undissolved pyroxyline in the form both of dust and fibres, or in fine organic dust from impure sources of manipulation. To remedy the evil, allow the collodion to settle thoroughly, and use only the clean supernatant part.

Transparent Spots.

These are of much more frequent occurrence than opaque spots. They may arise, in the first place, from undissolved particles of the iodides in the ether and alcohol of the collodion; this is particularly the case with iodide of potassium in anhydrous alcohol; these afterwards become dissolved in the subsequent operations. The remedy is a drop or two of water, or of diluted alcohol, or of bromide of ammonium.

As remarked in reference to opaque spots, particles of dust in the camera, or of the insoluble iodide of silver in the bath, adhering to the surface of the collodion, produce specks, both opaque and transparent. The transparent ones result from the fact that, during exposure, the dust particles being opaque, they prevent the rays of light from acting actinically on the collodion film beneath, and then, being washed off in the subsequent manipulations of development, fixing, intensifying, and washing, they leave the collodion in those parts to the mercy of the fixing solutions, which render them quite transparent. The remedy is to keep the camera and the room free from dust, and the bath from insoluble particles of the iodide of silver or organic materials. If the bath is the cause, the trouble may be avoided by keeping the plate in motion during sensitization.

Another cause of transparent spots, and probably a very frequent one, is to be attributed to a crystalline deposit of iodo-nitrate of silver, which, as the bath becomes weaker, is precipitated in a crystalline form on the surface of the collodion film. This form of deposit occurs with an old bath. Its remedy is to precipitate it out of the bath by adding water, and then by filtration. Then for every ounce of water thus added pour in, after filtration, the same amount of a 60-grain nitrate of silver solution to bring the bath up to its proper strength.

When the bath is the cause of transparent spots, a small quantity of a solution of chloride of sodium (common salt) thrown in is found to be of great benefit. Chloride of silver and nitrate of soda are formed by double decomposition; the insoluble chloride probably carries down with it the dust or particles which are the cause of the trouble, or the nitrate of soda dissolves them. I am not able to say what is the true explanation. After filtration the bath is raised to the proper strength, when it will be found to be free from the evil.

Ridges and Undulating Lines.

These are caused by the too great consistency of the collodion, and are found in the direction of the current of the collodion. The remedy is to add sufficient ether to cause the collodion to flow smoothly, easily, and uniformly

over plate. The mottled appearance sometimes apparent on a collodion film, as if covered with flocks of wool, is owing also to the thickness of the collodion, and the evil is remedied in the same manner as the ridges.

Streaks and Stains.

A deficiency of acid in a new bath may be the cause of the plate being covered with streaky lines in the direction of the dip; to remedy this, acid must be added cautiously until the lines disappear. In an old bath the accumulation of ether and alcohol may be the cause—remedy, boil the bath for some time, and filter—then mix it with an equal bulk of 30-grain silver solution.

Streaks may arise from an irregularity in the immersion of the plate in the silver bath, or in withdrawing it; the plate has to be immersed or withdrawn without any stopping. Streaks and stains are produced, too, by the film of dust swimming on the surface of the vertical bath, which is carried down on the collodion when the plate is immersed.

They arise, secondly, from the irregular flowing of the developing solution; the remedy is to use the gutta percha developing dish already recommended for such purposes. Another remedy may be a proper quantity of alcohol added to the developer, if there happen to be a sort of greasiness or repulsion in the collodion film to the developing solution as it flows along.

The part upon which the developer first comes in contact with the collodion film almost invariably exhibits a streak around a denuded part, as if the developer had swept off the latent image in that part. The remedy is the developing dish, by which the developer acts with little or no momentum greater at one part than at another.

A sort of fortification system of stains and streaks arises from the want of cleanness of the corners of the plate-shield, from an inferior quality of collodion, from the unequal dryness of the film before immersion in the silver bath, as well as from a too great and irregular dryness of the film after exposure and before development. The remedies are self-apparent: avoid the causes.

Stains of a blue colour arise from imperfect washing between developing with iron and fixing with cyanide of potassium.

Feebleness of the Image, or Deficiency of Contrast.

A new collodion will very frequently be one cause of this trouble; the materials are not yet ripe. As a remedy, add old collodion, or wait for a few days, until the collodion is sufficiently decomposed.

Over-exposure is another and very frequent cause of a feeble contrast in the picture. All the parts are developed simultaneously, and too much deposit of reduced silver is the result all over the picture. A shorter exposure is the remedy.

Too intense a developer, or a developer continued too long, fogs the picture, and weakens the contrast.

Imperfect lighting is a third cause, in which the light is either small in quantity, or diminished in intensity by reason of peculiarities in the atmosphere.

Harshness, or Excess of Contrast.

Under-exposure, a too acid bath, a too acid developer, under-development, an old and insensitive collodion: all these will produce pictures of mere black and white; the intermediate tones are totally wanting. The remedy is apparent: use it as the case may be.

Imperfect Definition.

This may be caused by the want of coincidence in the chemical and luminous focus. See that the surface of the ground glass and that of the inserted plate have exactly the same distance from the back lens, and correct this evil according to rules already laid down.

The want of sharpness may arise from careless focussing, from the mobility of the sitter during exposure, from a change of position in the camera when inserting the sensitized plate, or, in fine, from a bad lens. The remedy in every one of these cases is obvious, excepting perhaps in the last; for the photographer may not always be in a condition to get a better lens. In many cases a microscope is employed in very refined focussing, especially in copying, in order to secure the most perfect definition.

Solarization.

This trouble does not occur very frequently; it is made manifest by the redness which the high lights are wont to assume during development, when the exposure has been either too long, or the light too brilliant, as in the copying process by the direct rays of the sun. The evil can be remedied by avoiding the causes, or by the use of a bromo-iodized collodion, or of citric acid in the developer.

Tender and Rotten Films.

These occur generally in collodion of a certain make, owing to the peculiar nature of the pyroxyline, or the relative quantity of alcohol and ether. The defect may arise, however, by immersing the plate too quickly into the silver bath before the film has set; also by immersing the plate when the film is too dry, in which case it cracks and splits up in the development.

There is no remedy for a rotten film; but a tender or structureless film can be retained on the glass by first filing the edges as recommended, and then by careful manipulations in the various operations of developing, fixing, and washing.

Imperfections in Paper Prints.

These are to be attributed to defects in the paper; to imperfect albumenizing and salting; to defective sensitizing; to defects in the printing, or in the negative; to imperfect washing previous to toning; to defective toning; to defective fixing; to stains of various kinds; mealiness on the print.

Defects in the Paper.

A defective piece of paper must always be rejected at once. By regarding the paper by transmitted light, very frequently imperfections in the substance of the material can be descried, which otherwise would escape observation. Particles of inorganic matter, such as lime, the oxide of iron, &c., may be found in the substance, which, in the various stages of the printing operation, become manifest by decomposition. In choosing paper, where you can make the selection, examine each sheet separately for mechanical defects, both of structure and of contamination, and reject whatever is in any way defective.

Imperfect Albumenizing and Salting.

The albumenizing and salting require careful and neat management. If the albumen is not very thoroughly broken up, it will assuredly produce irregularities in the albumenizing. The salting materials must not be mixed up at the same time with the albumen, but after solution in a small quantity of water; otherwise particles of the salt will remain undissolved and give a spotted appearance to the printing. Use the albumen while fresh. See that the

surface is not composed of bubbles; where these exist you will have a marbled or oölitic appearance on your print. If the paper exhibits such minute bubbles when removed from the salting solution, break these bubbles all up with a clean feather or soft sponge, and float the paper again until the film is uniform. The amount of salting, as before observed, ought to bear a relation of equivalents with the silver solution used subsequently.

Defective Sensitizing.

Filter the silver solution before use, or at least remove all particles of dust or oxide from the surface, otherwise your prints will be spotted, and frequently covered with fortifications. A marbled appearance is caused by a weak silver solution, or too short a time of floating. It may arise from defects in the albumenizing, as just referred to. In quick floating, the solution must be very strong. In some cases, the solution seems to be rejected from the surface of the albumen: rub over the solution with a tuft of cotton; float again, and the trouble will be overcome.

Defects in the Printing or in the Negative.

A weak negative will inevitably produce a weak print. Weak prints, too, are the result of too dilute a silver solution. Bronzing arises frequently from a want of true relation between the lights and shades in the negative. An intensified positive used as a negative will produce a bronzed picture. Thus, under-exposure and over-development are the causes of bronzing.

A harsh print proceeds also from under-exposure and over-development in the negative: there is a want of middle-tone—the picture is all black and white.

Many prints are spoiled in the act of printing by extreme carelessness. Watch the operation. The two guides of success are: print as long as the high lights are perfectly white, and bronzing has not yet commenced. The impression of a perspiring finger on the sensitive film, as well as many other similar organic contaminations, also gives rise to bronzing.

Imperfect Washing previous to Toning.

The print, when removed from the printing frame, contains nitrate of silver and nitrate of the alkalies used in the salting solutions, albuminate of silver, chloride of silver; the latter salt has been partly acted upon by light, so as to form the picture, and another part has not been changed. The nitrates must all be removed by careful washing in several waters before the toning is commenced, otherwise the toning will be slow and imperfect.

The operation of washing must take place soon after printing and immediately before toning, in order to secure a good and quick tone.

Defective Toning.

This imperfection may arise from contaminations introduced into the toning solution by imperfectly washed prints; the gold solution becomes thereby decomposed and incapable of toning the printed film. The defect may arise from impure chloride of gold, from an acid condition of the toning solution, from bad paper, from the lowness of the temperature, from an excess of elevation of temperature. The imperfections of toning are:—

A red tone after fixing: this is owing to an insufficiency of toning.

A blue tone after fixing: this is owing to an excess of toning, or to an acid toning solution.

A yellow tone in the whites after fixing: this may be owing to imperfect washing, imperfect toning, imperfect fixing, dirty fingers, introduction of hyposulphite of soda into the toning solution or upon the prints. The de-

fect in question may arise also from the decomposition of the gold in patches, for want of uniform mixture before the prints are introduced.

Defective Fixing.

A dark mottled appearance in the body of the paper indicates imperfect fixing combined with the action of the light on the unaltered chloride during fixing. An exhausted hyposulphite bath may also give rise to this defect. A bath containing hydrosulphuric acid, or a free acid, which will produce the former, gives rise to this dark gray mottled defect.

A yellow tone in the whites arises very frequently from sulphurized hyposulphite stains of various kinds.

These are owing to irregular and careless manipulations. The introduction of the fingers into the various baths, and indiscriminately from one bath into another, is the cause of a number of stains on the prints as well as of abnormal action of the baths themselves.

Make rules for yourself, such as the following, and observe them minutely:—

1. Print just to bronzing, or until the whites begin to be affected.
2. Wash soon after printing, in clean water and clean vessels.
3. Move the prints about in the washing; repeat the washing six or seven times; five minutes' duration for each is, in my opinion, enough. Long washing I have found to be injurious.
4. The chloride of gold must be pure; the solution must be neutralized with alkali or lime.
5. The toning solution must be warm—about 100°—and well mixed and clean.
6. Wash after toning quickly—in warm or hot water preferable—take care to introduce no gold solution into the fixing solution, and *vice versâ*.
7. Move the prints about in all the solutions, so as to avoid bubbles and uneven action.
8. Tone to purple or incipient violet.
9. Use fresh toning for a fresh batch of prints.
10. Add fresh hyposulphite every time to the old bath, or use a fresh fixing bath every time. Let the bath be warm.
11. Alcohol is an advantage in all the solutions, beginning with the nitrate of silver to the hyposulphite of soda.
12. Wash very thoroughly after fixing.

Mealiness on the Print.

Some authors speak of this defect in albumen prints. It is said to proceed from paper that has been long albumenized, or from the paper itself. The remedy is to immerse the prints in a solution of two ounces of water and eighteen grains of acetate of soda, and to keep them in this liquid for about ten minutes.

Prints frequently appear as if covered with snow, but the surface is quite smooth and the whites clear; this defect is attributable to the negative which has been strengthened by pyrogallic acid containing too much nitrate of silver. The surface of the negative becomes thereby covered with a pulverulent deposit. There is no remedy for such a negative; there is a remedy, however, to such a mode of intensifying. In the first place, the negative must contain the middle tones before you begin to intensify; secondly, intensify slowly, which is effected by adding only three or four drops of silver at a time to the pyrogallic acid, and shaking well before use.

ENGLISH WEIGHTS AND MEASURES.

Troy or Apothecaries' Weight.			Avoirdupois Weight.		
20 grains	=	1 scruple			
60 „	=	1 drachm	27⅓ grains	=	1 drachm
480 „	=	1 ounce	437½ „	=	1 ounce
12 ounces	=	1 pound	16 ounces	=	1 pound

SYMBOLS.

Grain, gr. Scruple, ℈. Drachm, ʒ. Ounce, ℥. Pound, lb.

FLUID MEASURE.

60 minims	=	1 drachm		
480 „	=	8 „	=	1 ounce
160 drachms	=	20 ounces	=	1 pint
8 pints	=	4 quarts	=	1 gallon

WEIGHT OF DISTILLED WATER,

AT 60° FAHRENHEIT.

1 fluid drachm	weighs	54·7 grains	avoirdupois	
1 „ ounce	„	437½ „	„	
1 „ pint	„	1¼ lb.	„	
1 „ gallon	„	10 lbs.	„	

FRENCH WEIGHTS AND MEASURES.

1 gramme *weighs* nearly 15½ English grains (15·433)
1 „ = 10 decigrammes = 100 centigrammes = 1,000 miligrammes.
1 kilogramme = 1,000 grammes = nearly 2¼ lbs. avoirdupois (2·247).
1 litre *measures* nearly 35¼ fluid ounces (35·2).
1 cubic centimetre *measures* nearly 17 minims (16·896).

The Wothlytype.

This is a printing process with the salts of uranium and silver, collodion being used as the vehicle for same. It is patented, and takes its name from the patentee, Herr Jacob Wothly. It was introduced to photographers in this country by the United Association of Photography as a great novelty, but it is merely an adaptation of a process practised several years ago by Mr. Burnett. It is capable of considerable development and improvement, and possesses features of interest that lead to the hope of its being ultimately a very useful and certain method of photographic printing. The process is as follows:—Take a good photographic paper, Rive or Saxe, and cover the surface with some simple medium, such as arrowroot, starch, albumen, or gum tragacanth. The St. Vincent arrowroot is recommended by Mr. H. Cooper, junior, as the best medium for sizing the paper, as the collodion film adheres with the utmost tenacity to it, and it appears to be the most suitable form of organic matter which is necessary in the process to facilitate the reduction of the salts employed, and give brilliancy and depth to the pictures. Some care is required in preparing the starch. The arrowroot must be first crushed in a bason, and made into a paste with a little cold water; then boiling water added, a little at a time, and the mixture stirred till it is of a proper consistency. 200 grains of arrowroot, dissolved in 10 oz. of boiling water, has been recommended as the proper quantity to be used. The contents of the bason should be smooth and transparent, and must be set aside till quite cold. If too much cold water be added to the dry arrowroot in the first instance, the mixture will not be clear; to remedy this it must be boiled. When cold, the upper portion must be carefully skimmed off, as it is much thicker than the rest, and if it were allowed to remain it would cause imperfections in the picture. The paper is coated with arrowroot by means of a sponge or suitable brush, taking care to avoid air bubbles and streaks. When properly coated the paper is hung up to dry. When perfectly dry it must be rolled, which, if skilfully done, will impart a very fine surface to the paper. An ordinary rolling machine will do, but one with a glass bed is to be preferred. Next take an uniodized collodion giving a rough glassy film. Collodions are now specially prepared for this process, so there is no difficuly in procuring a suitable sample.

Add as much nitrate of uranium as it will take up—about 40 grains per oz. will be the quantity—then add 4 grains of nitrate of silver to each ounce of collodion, which may be done in the following manner :—

Make a strong aqueous solution of nitrate of silver, say 40 grains to an ounce of water. As there are 240 minims in a fluid ounce, the solution will contain exactly 1 grain of salt to each minim; consequently the number of grains of silver required in the collodion can easily be added to it by this means. Or nitrate of silver may be added to the collodion to saturation; that is as much as the collodion will dissolve. After the collodion is sensitized, the next thing to be done is to coat the prepared paper with it. The paper must of course be quite free from dust, and the coating with collodion must be done in the dark room, which must also be quite free from that source of annoyance and failure. The paper is laid upon a perfectly flat smooth piece of wood of corresponding size (which should have a handle underneath), and pinned down at each corner, except that from which the sensitized collodion is to be poured back into the bottle; it is then coated like a plate of glass and hung up to dry. Glass slips are recommended as suspenders for the drying of the paper. When dry it is ready for exposure under the negative in the ordinary way.

The general experience is that properly prepared collodionised paper is as sensitive as excited albumenized paper. Various samples of paper print to various tints; some to a deep brown or bistre, some to nearly a black, some to a bronzed green, and some to a sandy brown or orange. According to Mr. Cooper and Mr. Simpson, paper printing, to these last-mentioned colours is more difficult to tone than the others. Very little over printing is required; in fact, in most cases none at all is requisite.

The prints after leaving the pressure frame are placed for about 15 minutes in a weak bath of acetic acid, 3 parts of acid to 100 parts of water, which renders the high lights perfectly clean and white. After this they are well washed in water, previous to being placed in the fixing and toning bath, which is made as follows :—

Sulpho-cyanide of ammonium	½ oz.
Distilled water	4 oz.
Chloride of Gold	1 grain.

Prints immersed in this bath are toned and fixed at the same time, and a fine purple or black tone may be produced by its use. If the bath be found to work too energetically it must be diluted with more water. The bath

may be used over and over again until exhausted. When taken out of the toning bath the prints must be well and rapidly washed; a preliminary sponging has been recommended, but nothing can be gained by such an operation. The prints are then mounted and dried in the ordinary manner. It has been said that simply washing in water is sufficient to fix prints obtained by this process, but experiment has demonstrated this to be a fallacy. The holders of the patent right in England have given permission to amateurs to make use of the process free and without restriction. Professional photographers are compelled to take out a license should they desire to work it.

Fox's Patent Printing Process without the Nitrate of Silver.

THE inventor, Mr. Thomas Fox, claims for this process, that is simple and rapid, and that the ingredients required are of the cheapest description. That it also produces very vigorous pictures; the deepest shades being an intense black, equal, if not darker, than that given by any known process. It is the exact counterpart from printing with nitrate of silver, and whitens the paper where exposed to light, the shaded parts becoming black, and yielding very fine and soft gradations of tone.

The process consists of bringing the bichromate of potassa into direct contact with logwood; and the plan adopted by Mr. Fox is to sensitize the paper with a saturated solution of bichromate of potassa and sulphate of copper, mixed in the proportions of one part of the former to two of the latter, by either floating or steeping the paper in this solution for a few minutes; it is then dried by artificial heat in the dark. Paper so prepared will retain its sensitiveness several days if carefully protected from the light. Prints may be obtained on this sensitive paper by means of a glass transparency—that is a *transparent positive*, or from a paper print. When the glass transparency is used, the printed side must, of course, be next to the sensitive side of the paper; but with paper prints, it does not appear material whether the printed or unprinted side is placed next the excited side of the paper. With the printed side down, you get a reversed picture, which will do admirably for transferring.

The exposure required is about the same as when printing with paper sensitized on an ordinary silver bath. In direct sunlight from one to three minutes is sufficient when a glass transparency is used. When a paper print is employed, of course the exposure will depend upon the thickness of the paper; therefore, the thinner it is the better. In dull weather, and in diffused light, the time of exposure is, of course, longer. A strong decoction of logwood is prepared in the ordinary way, and filtered. After the paper has been exposed in the pressure frame, it is floated on a bath of this decoction of logwood, to which a little warm water has been added to facilitate development, the sensitized surface, of course, being downwards. The time required for the development of the picture will vary from half a minute to a minute, and it must be floated on the logwood solution, and raised from it by seizing one corner, with the same care as requisite when sensitizing albumenised paper on the silver bath. When thoroughly developed, the print is washed in hot water, and afterwards dipped in hot water containing alum, to improve the whites; it is then dried and varnished.

The same logwood bath will do for a great many prints, and the sensitizing solution retains its power until the last. By varying the strength of the sensitizing and developing solution, different shades of colour may be obtained. The paper used in this process should be albumenised, or gelatinsed; the latter, the inventor believes, will be the best, but we prefer the albumenised.

The Carte de Visite Process of Mr. T. R. Williams,

Photographer to Her Majesty.

THE study of photography, like the study of every other art, is beset with difficulties, and excellence is only reached by assiduous attention to every detail of proceeding and by long practice; for, as the old adage has it, practice makes perfect. Students in photography often fail as beginners, but, as the esteemed writer of the treatise on "Instantaneous Photographs" in this work has said, such failures should only urge them on to renewed and more

strenuous exertions, by which success may be assured. The idea which many have about secret formula is most fallacious, and it is principally to remove this idea, and to show them that the best photographers of the day produce their works by acting up to the rules laid down in the various chapters of this book, that we condense a communication from Mr. T. R. Williams to the "*Photographic News*," * on the subject of "*Photographic Portraiture.*" From this they will see that strict attention to all the manipulatory details, cleanliness, and the absolute purity of all chemicals used, with the addition of good taste, is all that is necessary to the production of good photographs.

Mr. T. R. Williams writes—

"*The Glasses* should be of the best patent plate, and a stock should always be kept ready, very scrupulously cleaned. They should be as little handled as possible prior to coating. A small shelf in my operating room is kept for this one purpose only; the cleaned glass plate is removed from its box and placed on this shelf, leaning against the wall. Between two pieces of millboard, resting on the shelf, is kept a flat camel-hair brush, with which to remove the final traces of dust from the plate before coating. This brush is never allowed to lie about, but is placed between the millboards the moment it is done with, as it is important that it should be perfectly clean.

"*The Collodion.*—I have obtained good negatives with almost all kinds of collodion, by modifying my operations according to their requirements. I use from time to time samples made by various of the well-known makers, and select that for general use which at the time gives the best results. I have not found any so constantly good as to be superior to all others; my selection is therefore based upon experiment made when required. I prefer a bromo-iodized collodion with a full body, giving a creamy film in the bath, and a fair amount of vigour with the iron developer, without any foggy deposit on the shadows.

"*The Nitric Bath.*—I have occasionally been much perplexed with the nitrate bath, which, made with purest nitrate of silver to be obtained, distilled water free from suspicion of contamination, and carefully treated in all respects, *secundem artem*, would still yield foggy pictures from the first, or, if working well at first, would break down in a few days and become

* The Photographic News. Edited by G. Wharton Simpson, Esq., and published by Piper, 32, Paternoster Row, London.

worthless. The best practical skill I could apply, and the profoundest chemical knowledge I could consult, failed in such cases either to detect the cause or find a remedy. I have but little time for experiment, but I have not found doctoring of much avail in such cases; the simplest plan has been to throw the solution aside for reduction, and make a new bath with a fresh sample of materials. These perplexing cases have, however, been rare.

"I now generally use the commercial sample of recrystalized nitrate of silver, made by a well-known refiner, and I find it to all photographic intents perfectly pure. In winter I find that the bath is better for containing 40 grains to the ounce; but in summer it should not exceed a strength of 30 grains. It is made in the usual manner, and has a grain or two of iodide of potassium added to each pint of solution. A trace of nitric acid is added just sufficient to turn litmus paper in a few hours. It is better to keep two baths constantly in work, and when they get out of order I prefer making a new one to doctoring the old solution. I prefer to use the plate as soon after it is ready as possible, and an assistant is ready to hand me the plate in the dark slide from the dark room the moment the sitter is properly arranged.

"EXPOSURE AND DEVELOPMENT.—These two operations depend more on each other than is often thought. The developing solution is, of course, modified to suit circumstances; but that which I most commonly use consists of 15 grains of protosulphate of iron, and sometimes the double sulphate, to an ounce of water, with 15 minims of acetic acid, and alcohol sufficient to make it flow freely. The solution is generally used when not more than a few days old. The operation of developing, whilst one of the most important in photography, is just one of those which can be least easily described in words. I suppose that the simple knack of covering a plate with the iron developer, without causing marks and stains, must be difficult to some persons; but I do not fancy that any attempt to describe the method would communicate to them that manipulative skill which can only come from practice, and which seems so natural to the experienced photographer, that *he* is inclined to wonder how others contrive to fail. I can only say, that it is necessary to cover the plate with one light sweep of the solution, so that it shall flow in one steady wave, and without causing a stain where it first touches the plate. This done, the continuance of the operation demands the careful attention of the practised eye and experienced judgment. There is less

danger with iron development than with pyrogallic acid of carrying the operation too far; but it is very easy to fail to go far enough.

"The extent of the development depends, as I have said, very much upon the exposure; and upon the exposure depends much more than appears to be generally believed, the excellence of the negative. The prevalent fault of photographers is under-exposure. It is believed by some authorities, and not without reason, that over-exposure calls into operation an optical cause which induces softness and removes harsh, hard, sharp outlines, by giving time for some of the outstanding rays which are not brought to a perfect focus by the lens, to produce a slight action on the plate. I will not pause to discuss that here, but I repeat very emphatically that upon a full exposure depends more of delicacy, roundness, and general harmony than upon any other single operation in portraiture. Upon full exposure depends almost entirely the removal of the coarseness produced by freckles, coarse skin, red hair, wrinkles, scars, &c. The exposure being sufficient, there is little danger, if the chemicals be in good condition, of over-developing. It might almost be stated as a rule that the iron development may be continued in such case as long as there is no deposit on the deepest shadows. The last point is, however, of great importance; the deepest shadows of the picture must present points of almost bare glass in the negative in order to secure brilliancy. If the development be continued so long, or if the condition of the chemicals be such that there is a general reduction or deposit all over the plate, although softness may be obtained, brilliancy is irretrievably gone. If the exposure have been rather short, and the development be pushed to secure detail, it will be impossible to secure a delicate image; the picture may appear both brilliant and full of half-tone, but it will not be really soft and delicate; there will be a slight harshness which the inexperienced eye will be somewhat at a loss to reconcile with the fact that the picture is full of detail.

This should be remembered, as a golden rule, that it is better to obtain half-tone by full exposure than by forced development; that whilst the latter may bring out detail, the former only can give delicacy and softness.

"INTENSIFYING.—The appreciation of the real printing value of a negative can only be acquired by experience and long and careful observation. The capacity to see in the various degrees of density in a negative the gradations of tone it will produce in a print, is a most important power, and one which should be sedulously cultivated by the photographic student. With-

out this power, he may occasionally produce a good negative by chance, but he cannot hope for uniform excellence. This knowledge is absolutely necessary in determining whether a negative needs intensifying, and to what extent the intensifying must be carried, and also to determine the mode of intensifying to be adopted. If the exposure have been in any degree insufficient, or if the image, from the character of the collodion and other circumstances, be somewhat wanting in vigour, the intensification is effected before fixing, by means of a solution of pyrogallic acid and a few drops of a fresh 15-grain solution of nitrate of silver. If, however, as is usually the case, the negative possesses good gradations and a moderate amount of force after finishing with the iron, it is fixed, washed, and set aside to be intensified after fixing. This is done before it has dried, and after a very thorough washing by the application of 1-grain solution of pyrogallic acid, containing about 15 minims of acetic acid and a few drops of the 15-grain silver solution, applied in daylight. Care is used to avoid stains, and especial care to avoid excess of intensity. As a rule, on holding up a negative to the light, it is possible to distinguish the interruption to the light caused by the sash-bar of the window through the densest part of the face. In intensifying with pyrogallic acid and silver, the aim is really rather to give the grey image of the iron a brown non-actinic colour, than to pile up much additional deposit, which would often produce coarseness and harshness.

"I used for some time the process of intensifying with bi-chloride of mercury, followed by iodide of potassium, which was practised and recommended by the late Mr. Lacy, whose fine pictures gave such promise of a high career in photography. The process when well managed gave very fine results. It was, however, somewhat difficult at first to hit exactly the right kind of negative for the purpose, and to use the mercury and the iodide in just those proportions which gave the best result; and there was also the unfortunate liability which such negatives sometimes have, to grow harder and denser under the action of light. These characteristics induced me, after trying it for some time, to abandon it for the method to which I have just alluded, which is thoroughly within control, and gives but little trouble.

"Fixing.—I always fix with hyposulphite of soda, using a saturated solution in a dipping bath. It gives a negative of more non-actinic colour, and is less apt to destroy the half tones than cyanide of potassium.

"VARNISHING.—After a very careful washing, the negative is placed away to dry, and is then varnished with Sœhnée varnish, and is then ready for the printer."

Transparent Positives.

A TRANSPARENT Positive is the reverse of a negative. The reader will understand by that, that where in a negative the deposit is the most dense, in the corresponding transparent positive there will be bare glass. Transparent positives are employed in the stereoscope, and also as slides to the magic or demonstrating lantern, and also for printing purposes and enlargements. The apparatus required for their production by the wet collodion process will be found described in the chapter on "Enlargements," page 74, in this book; or a box or tube made of wood, sufficiently large to admit the camera intended to be used, and having a receptacle at one end for negatives, may be employed. Great accuracy must be observed in getting the focus, as the positive is worthless unless sharp, well defined, and free from distortion. When placed in the frame for the purpose of producing transparent positives, the negative is inverted laterally, that is, the sides have changed places, left being right, and right left; and the collodion side is inwards, or facing the lens. The compound camera is then pointed to a white cloud, or directly to the sun. The image must be accurately focussed on the ground glass; and as it is much more difficult to obtain the right focus in such work than in ordinary portraiture, it is advisable to make use of a good focussing glass to obtain the requisite exactness. Slide the camera in the tube, or along the baseboard, until you think you have got the sharpest definition, and afterwards make the final adjustment with the aid of the focussing glass. Inasmuch as the lens is within the tube, all the focussing has to be done by sliding the camera; and when once the right focus has been found, the cylinder and camera are firmly fastened, and a mark is made by which at any time afterwards the adjustment can be quickly made, and the trouble of focussing on each occasion thereby avoided. When the direct rays of the sun are used and a small stop is employed to secure marginal definition, from one to three minutes' exposure will be

required with the orthoscopic lens, and from 25 to 60 seconds with a portrait lens. As to the coating of the plate with collodion, sensitizing, developing, &c., the reader is well instructed in these operations, and there is no need to detail them in this chapter. A transparent positive, when developed with sulphate of iron, is of a grey colour; and it is necessary, in order to secure proper effect, to change this to a darker hue. This is effected by pouring over the film a sufficient quantity of a saturated solution of neutral bichloride of mercury. As soon as the film is black, pour off the mercury and wash the plate well with water.

The plate is next covered with a solution of cyanide of silver in cyanide of potassium, which is made thus:—Take 100 grains of cyanide of potassium, and dissolve in two ounces of distilled water; add solution of nitrate of silver, containing 50 grains to the ounce, as long as the precipitate is dissolved. Do this slowly. This solution, after filtration, is ready for use. The image, when covered with this solution, assumes an intense black hue, and the solution may be used over and over again, until exhausted. The plate is next washed carefully and thoroughly, and again fixed with *hyposulphite of soda*, but not with *cyanide of potassium*, because that would reduce the silver to a white film again.

Transparent positives are produced by the dry collodion process in the following manner:—In the first place we require a negative, sharp in all its parts, moderately dense in the light, and quite transparent in the deepest shadows. The film must be thin, bright, and free from all deposit of dust arising from reduction or impurities. Dry plates prepared by the the Tannin process, or Dr. Hill Norris's process, may be used for the production of the positives. Instructions for preparing these will be found at page 68. They are placed in contact with the negative, in the same way that sensitized paper is. With a good light the exposure of a few seconds is all that is needed. The plate is then developed, washed, and fixed, as detailed in the chapters on the "Dry Processes," and may be coloured with bichloride of mercury, &c., as described in the first part of this chapter, if needed.

The Eburneum Process.

THE process is one of the novelties of the art,—essentially a fancy process—but which gives pictures of a very pleasing character, and it is therefore deserving of notice as being one of the few innovations in Photography recently made public which are of sufficient merit to attain anything approaching to popularity.

The picture by this process is obtained by camera printing after the manner adopted to obtain transparencies by the wet process, which will be found described in the preceding chapter, and receives a backing of white gelatinous tissue, termed "*Eburneum*," just in the same way that an ordinary glass positive is backed up with black varnish. In fact, an "*Eburneum*" picture is the reverse of an ordinary glass positive, for in the "*Eburneum*" process we get the whites of the picture by the application of an opaque white varnish, and the shadows and their gradations are formed by the reduction and toning of the silver in the collodion positive, whereas in the ordinary positive on glass we have a white collodion picture, and black varnish for the shadows.

The following details must be carefully observed. Take the glass (patent plate), which must be free from scratches and blemishes, thoroughly clean it—for dust and dirt is as fatal in this process to good results as it is in any—and then cover it with a very thin coating of wax. In order to do this you must make a saturated solution of bees wax in methylated ether; the bottle containing which should always be kept carefully corked to exclude dust, and prevent the evaporation of the ether. Take a little of this solution and spread it rapidly over the surface of the plate by means of a tuft of clean cotton wool. The ether quickly evaporates, leaving a coating of wax on the glass, which is too thick and uneven to answer the purpose for which it is used. The plate has therefore to be polished with a clean linen rag, kept specially for the purpose; it will then have a very thin and almost imperceptible coating of wax, which, however, is quite

thick enough for the object in view. In polishing the plate to get rid of the superfluous wax, you need not be afraid of rubbing off all the wax, as it is almost impossible to do that if you allow the ether to thoroughly evaporate before you commence to polish the plate. The object of using the wax is to facilitate the transfer of the collodion film from the glass in the manner which will be described hereafter. It will be necessary to have a six grain india rubber solution in benzole ready; dip a camel's hair pencil in this, and coat the edge of the plate with it to the width of about the eighth of an inch. When this is dry, and you have assured yourself that there is no dust on the plate, coat it with ordinary good negative collodion, and immerse it in the nitrate of silver bath as if you were going to take an ordinary negative. The bath may be your negative bath, but see that it is in good working order. Perhaps before we had gone so far we ought to have told you to get ready the negative from which you are going to print. You must place it in the copying camera as you would for obtaining a transparent positive, and the image must be accurately focussed on the ground glass screen. Then place your sensitized plate in the camera and expose—you may know the right exposure has been given when, in developing, the half-tones show before much depth is obtained in the shadows. Careful observation is necessary to determine the right exposure, therefore the student need not be discouraged by one or two failures at starting.

The picture is developed in the usual manner, and Mr. J. Burgess, the inventor of this process, recommends two developers, one with iron and one with pyrogallic acid; the iron developer to be used if the negative is very vigorous; the pyrogallic developer if the negative is weak and the light strong.

IRON DEVELOPER.

Proto-Sulphate of Iron	5 grains.
Citric Acid	5 ,,
Glacial Acetic Acid	10 minims.
Water	1 oz.

PYROGALLIC ACID DEVELOPER.

Pyrogallic Acid	from 3 to 6 grains.
Citric Acid	3 ,,
Glacial Acetic Acid ...	20 minims.
Water	1 oz.

Develop as you would a negative, fix in a solution of cyanide of potassium, well wash and tone with gold until the tone shows at the opposite side of the glass. If you desire the colour of the picture to be brown, cover the plate with a saturated solution of bichloride of mercury, and allow it to remain on until the image is white quite through; then wash off thoroughly, and cover the plate with a weak solution of hydro-sulphate of ammonia, viz. :—water 1 oz., hydro-ammon., 6 or 8 drops. The tone will be found to vary with the quantity of ammonia used. After toning wash well under the tap, and allow the plate to dry spontaneously. When it is intended to use the bichloride of mercury toning bath, Mr. Burgess recommends that the exposure should be longer and the development shorter than with the gold toning bath.

We have now to take into account the substance from which the process receives its name, viz., "*Eburneum.*" This substance is nothing more than gelatine with which is thoroughly incorporated zinc or Chinese white. It may be made in sheets in the same way that Mr. Swan's carbon tissue is made—of course substituting zinc or Chinese white for the carbon or Indian ink—*and omitting the bichromate of potash.* Sheets of this substance may be kept between the leaves of a portfolio until required for use. When wanted cut a portion the size of the plate on which your picture is taken and soak it for a few minutes in a bath composed of 1 oz. of water and 2 drms. of alcohol. Moisten the picture on the glass with the same mixture and then place the sheet of "Eburneum" on the picture, so that the gelatine side rests upon it and the collodion side is uppermost, and bring the surfaces into contact by pressing the Eburneum on the picture, beginning at one side and progressing to the other in the same way that you place a sheet of paper on the silver bath to be sensitized. By this means you drive out all the water and alcohol resting on the two surfaces which would otherwise form bubbles and prevent perfect contact.

The following is the formula given by Mr. Burgess for the "*Eburneum.*"

French clear gelatine	5 ozs.
Water	20 ,,
Glycerine	½ ,,
Oxide of zinc...	1 ,,

Soak the gelatine in water for a few hours, then dissolve by gentle heat and filter through flannel. Put the zinc into a glass mortar, add to it the glycerine and 1 oz. of water; when thoroughly mixed stir it into the warm

solution of gelatine and let it stand aside for two or three hours in order that the coarser particles may settle to the bottom, then decant carefully into a clean bottle, leaving undisturbed that portion containing the coarse particles, and it will be ready for use.

In order to apply this solution properly, Mr. Burgess pastes narrow pieces of paper round the edges of the plate at the bottom and then turns up the edges of the paper, so that when the plate is laid down, collodion side uppermost, a sort of dish is formed into which the "*Eburneum*" solution can be poured. The plate should be placed on a stand and made perfectly level with a spirit level, as it is necessary to have an equal thickness of the solution all over the plate. Then pour on the plate a sufficient quantity of *Eburneum* solution to give a moderately thin coating to the plate. When it has well set the plate may be placed in a warm room or closet, free from dust, where the temperature should range from 70 to 80 degrees Fahn., until the gelatine is thoroughly dried; or in as warm and dry a place as the student can command (*not too hot*), where there is no dust, until the same end is attained. It must then be coated with plain collodion, taking care to select such a collodion as gives a tough stout film, or it may be coated with varnish instead; a good negative varnish will do. You have then to run a penknife round the edges when dry, and the whole will leave the plate. The picture ought to have a beautifully polished surface equal to the glass from which it is taken, and should resemble in some measure a picture on ivory.

Mr. Cooper, jun., in a paper contributed to the "*Year Book of Photography*," for 1866, suggests the addition of pink and other tints to the white Eburneum solution to produce novel and pleasing effects, and also the addition of oil of lavender or otto of roses to the same, so that the Eburneum picture may be perfumed as well as tinted if so desired. No doubt a perfumed ivory-like picture would have a great charm to many, especially to the fairer sex.

Development with Iron and Gelatine.

Mr. Carey Lea, an American photographer, in the course of his experiments, combined a solution of gelatine and sulphate iron, and used it as a developer. This combination he found possessed certain advantages over the ordinary iron developer. It gave greater intensity to the picture, greater freedom from fog, and it flowed over the plate more evenly than the usual iron developer; therefore, in developing with this solution of gelatine and iron, there was less liability to stains and spots. These advantages are important, especially the restraining influence of the gelatine—or rather its combination with sulphuric acid, which is named glycocine, or sugar of gelatine—which enables one to prolong the use of the developer until all the details of the picture are visible, without the fear of producing fog.

Mr. Lea's method of making this developer was to combine an aqueous solution of gelatine with sulphuric acid, leaving an excess of the latter, and then to add iron filings, so producing a compound solution of sulphate of iron and glycocine. But Mr. Cherrill's modification is better than this original method. His plan is to make a solution of glycocine, and to add it to the ordinary iron developing solution.

Having procured some good strong gelatine, take 140 grains of the same and soak it in water until it becomes quite soft. When this is done, drain all the water away from it, and pour on it one fluid ounce of commercial concentrated sulphuric acid, and well stir it about with a glass rod. The gelatine will speedily dissolve, and when you are satisfied that it is quite dissolved, add four ounces of distilled water. This solution will contain an excess of sulphuric acid, which must be neutralized, and the solution rendered slightly alkaline by the addition of a strong solution of liquor ammonia, two fluid ounces being about the quantity required to produce a slight alkalinity. The solution must be left until quite cold, when you must add half a fluid ounce of glacial acetic acid. Then make the solution up to 16 fluid ounces by the addition of distilled water. Or instead of using sulphuric acid in combination with gelatine, acetic acid may be used.

Take 120 grains of gelatine, and pour on it six fluid ounces of distilled water. When thoroughly soft, add two fluid ounces of glacial acetic acid, which will speedily dissolve the gelatine. A gentle heat will accelerate the solution. These solutions must be filtered.

Presuming that a 30-grain solution of photosulphate of iron is made, it is necessary now to say in what proportion the gelatine and iron solution should be combined.

If the plate be over exposed, a large proportion of the gelatine solution may be used; if under exposed use a stronger iron developer—say 50 grains sulphate of iron to the ounce of water—and a small portion of the gelatine solution. For general work, with a fair exposure, about 1 drm. of gelatine solution to each ounce of a 30-grain iron solution will be sufficient. But the student will soon find from experience the various proportions of each solution which should be combined to produce the proper results under all variations of exposure, and his experience, after the hints given here, will be more valuable and trustworthy than the most elaborate table that could be

constructed with a view to guide him. When it is borne in mind that with a proper combination of the iron and gelatine solutions, it is frequently possible to obtain a negative sufficiently dense to print from without after intensification, the value of this modification will be apparent. The negative produced with gelatine dries of a very non-actinic colour, care must therefore be used not to make the image too opaque. The solutions must be kept well filtered, and if after developing and drying, the negative is found to have a slight coating of gelatine, it must be removed by carefully washing with warm water.

It has been stated by many photographers that the restraining action of the gelatine is mechanical, and that the viscid nature of the developer containing it is the cause of the rapid deposit of silver being prevented, in that way it having the same effect as a large quantity of free acid would have in the developer. But a developer made with gelatine has not the corrosive and other objectionable qualities of a developer containing a large quantity of free acid, and has at the same time all the good qualities of the latter, and more.

The developer will be found to work better a few days after it is made than immediately after making it; all sediment ought to have sunk to the bottom of the vessel containing it by that time.

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